DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

HEARINGS

BEFORE THE

JOINT COMMITTEE ON ATOMIC ENERGY

CONGRESS OF THE UNITED STATES

EIGHTY-FIFTH CONGRESS

FIRST SESSION

ON

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

1957

Section 202, Statutory Hearings

PART 2

(of two parts)

FEBRUARY 26, 27, 28, AND MARCH 5, 1957

Printed for the use of the Joint Committee on Atomic Energy

UNITED STATES
GOVERNMENT PRINTING OFFICE
80517 WASHINGTON : 1957

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DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

TUESDAY, FEBRUARY 26, 1957

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The committee met at 10 a. m., pursuant to recess, in room 219, Old House Office Building, Hon. Carl T. Durham (chairman of the Joint Committee) presiding.

Present: Representatives Durham, Holifield, Price, Dempsey, Cole, Van Zandt, Jenkins, and Senators Anderson, Dworshak, and Gore.

Also present: James T. Ramey, executive director; George E. Brown, Jr., and David R. Toll, professional members of the staff; and George Norris, Jr., committee counsel.

The CHAIRMAN. The committee will come to order.

This is a continuation of the hearings before the Atomic Energy Committee.

This morning we have with us Dr. W. E. Shoupp, technical director, commercial atomic-power activity, Westinghouse Electric Corp.

We are glad to have you with us, Dr. Shoupp. Do you have a statement?

STATEMENT OF DR. W. E. SHOUPP, TECHNICAL DIRECTOR, COMMERCIAL ATOMIC POWER ACTIVITY, WESTINGHOUSE ELECTRIC CORP.; ACCOMPANIED BY W. E. JOHNSON AND JACK K. BUSBY

Dr. SHOUPP. Yes, Mr. Chairman. We have filed with you a formal statement, and I would like to read to you an abbreviation of this statement.

The CHAIRMAN. You may proceed.

Dr. SHOUPP. My name is W. E. Shoupp. I am technicial director of the commercial atomic-power activity of the Westinghouse Electric Corp. My appearance here today is for the purpose of furnishing an interim report on the technical status and progress of the Pennsylvania advanced reactor project (PAR), a joint undertaking of Pennsylvania Power & Light Co. and Westinghouse Electric Corp. At my right is Jack K. Busby, executive vice president of Pennsylvania Power & Light Co., and on my left is Dr. W. E. Johnson, manager of the PAR project.

The phase I objective of the project is to determine by early 1958 the technical and economic feasibility of constructing and operating a 150,000-kilowatt plant of this type, for service on the P. P. & L. system by 1962. Assuming satisfactory results from phase I, phase

II will include the further development and engineering needed for the construction of the final plant and actual operation of the plant.

The aqueous homogeneous reactor appears to have real promise for central station application for several reasons, including (1) the possibility of attaining a breeding ratio of unity or near unity resulting in low fuel costs; (2) inherent safety resulting from a negative temperature coefficient of reactivity; and (3) the possibility of a continuous fuel reprocessing obviating the plant shutdown time needed by solid fuel element reactors for refueling. These indicated advantages led to the setting up of the PAR project through an agreement signed by the two companies on July 25, 1955.

Under this agreement, P. P. & L. and Westinghouse each appointed a representative with authority to carry on the project with an appropriation of $5.5 million over the period ending in 1958.

Shortly after the project got underway, the Union Carbide Nuclear Co. became a third member of the team and assumed the responsibility for the chemical reprocessing and waste disposal studies.

The project is now composed of 75 engineers and scientists and 35 technicians, for a total of 110 technical personnel, in addition to which Carbide is to supply 12 man-years of effort.

PAR has, at Pittsburgh, extensive laboratory and testing facilities, including physical chemistry laboratories, slurry preparation laboratories, and a large operation area for setting up and testing prototype plant equipment. Through January 1957, expenditures for the project, including firm commitments, amounted to $3.2 million. This does not include expenditures made by Carbide or the substantial outlays by other companies doing development work for PAR on a customer service basis at no charge to PAR. It is now estimated that the entire $5.5 million allocated to the phase I portion of the program will be spent by January 1958.

The PAR project has to date concentrated on the single region reactor concept using a slurry mixture of uranium oxide and thorium oxide in heavy water. This approach dovetails with, but avoids duplication of, the work of Oak Ridge National Laboratory on the two-region concept, which is designed to use a core of uranyl sulfate solution surrounded by a thorium oxide slurry blanket. Before final decision is made regarding phase II the relative merits of the single-region and two-region concepts will be evaluated.

The major technical feasibility questions which must be answered for a slurry-type reactor are (1) whether the slurry can be handled in the complicated mechanical and hydraulic systems required in such a plant, and (2) whether adequate components can be developed for use in such systems.

Our attack on the problem of handling slurries has been very intensive. The slurry needed for a single-region reactor consists of a mixture of about 250 grams of thorium oxide and 10 grams of uranium oxide per kilogram of water. If allowed to stand without any form of agitation the solid particles of thorium and uranium quickly settled to the bottom of the container leaving essentially pure water above them.

Typical of the extensive development facilities, are 13 loops, operating or under construction, for testing the behavior of slurries under various operating conditions. By the end of 1957 about $1.3 million

will have been invested in such equipment. These loops vary in size; our largest installation is to be a 10-inch-diameter loop operating at 600° F., 2,000 pounds per square inch and a flow of 4,000 gallons per minute which is one-half the proposed design flow for one loop of the final plant.

Preliminary answers to many of the important questions of handling and use of such slurries in high-pressure systems have been obtained. We now have firsthand experience on how such systems act if circulation is stopped and the slurry allowed to settle on the pipe and component walls.

Similarly, tests have been carried out to determine how to drain such a system after shutdown and information obtained on how much flushing and redraining is necessary to obtain quantitative recovery of the fuel of thorium and uranium initially charged into the loop.

The results from all of these tests have been uniformly encouraging, and strongly support the feasibility of actual powerplant operation. Even though much needs to be done on the properties of slurries under radiation, we now feel that for relatively pure slurries we can solve the handling problems facing us.

A special high-pressure and temperature slurry circulating loop to be placed in the new Oak Ridge research reactor in 1957 (ORR) is now being fabricated. This program is being jointly sponsored by ORNL and PAR to determine the effects of reactor irradiation on the behavior of slurries.

The second area of concentrated development work is the design and testing of components for use in slurry systems. Such equipment must be designed to meet two very unusual requirements. Flowing slurry may settle and clog equipment, also all equipment will become very radioactive as a result of plant operation. Therefore, the equipment must be designed so that repair or replacement work can be carried out by remotely operated tools.

The component development program was set up along three distinct lines. First, facilities and experiments were developed for testing prototype equipment such as circulating pumps, valves, makeup pump, heat exchangers, and instrumentation. Second, feasibility design studies of components for the full-scale plant were started either within Westinghouse or other manufacturers of large equipment. Third, steps were taken to deal with special problems of remote maintenance.

As regards prototype development purposes, four test loops have been constructed and tested in conjunction with valves, pressurizers, instrumentation, letdown devices, and various types of pumps.

As regards feasibility analysis of the construction of full-scale components, the best example of this type of activity is the design of the pressure vessel. Preliminary work indicated this vessel should be 10 to 15 feet in diameter and capable of withstanding a design pressure of 2,500 pounds per square inch. At the start of the project, it was not clear that equipment large enough to fabricate such a vessel was available anywhere in the entire country. As a result of design studies made for the PAR project by several pressure-vessel manufacturers, we have now determined the manufacturing feasibility of such vessels and are proceeding on the detailed design. Similar studies are well underway on most of the other major components of the final plant.

The remote maintenance of this equipment is also being examined in detail. As mentioned previously, once the plant has been operated, all the primary system components and piping become intensely radioactive and cannot be approached by personnel for even the shortest period of time. This means that if a piece of equipment is to be removed and replaced, it must be done using heavy-duty mechanical hands, remotely operated cranes, television equipment and special tools designed for the particular task. It must be remembered that the equipment being handled in this case is large, full-scale equipment and not laboratory-scale components. The feasibility of carrying out such tasks on a practical basis is a major question that must be answered before any large homogeneous reactor plant can be built. A large maintenance demonstration facility is now being designated to determine experimentally that such components can be disassembled and repaired using only remotely operated tools. It is intended that once such techniques have been developed they will be tested by actually maintaining the large loop completely remotely.

In addition to this work, we have been doing considerable plant engineering. We have undertaken preparation of a series of overall reference designs to determine the nuclear design of the reactor, necessary flowsheet data and physical layout of the plant. The purpose of these reference designs is to provide some guide in estimating ranges of capital costs. Our first design has been completed; the second is underway and we expect to finish the third by the end of phase I.

Our present outlook on estimated power costs is covered by the full statement I have already filed with the committee on pages 17 to 19 of that statement.

The results of our plant engineering work have been both encouraging and discouraging. The detailed reference designs have indicated that many of the auxiliary systems needed for this type plant are considerably more complicated than previously assumed. On the other hand, the results of our development program on the corrosion erosion of materials by slurries indicates our initial design parameters for slurry velocity were probably much too conservative and as a result our primary system piping can be decreased in size.

In summary, the PAR project has grown from an infant organization in August 1955 to a relatively large development and engineering group. After approximately 19 months of concentrated effort, we feel that we have made definite progress. We must recognize, however, that we are looking ahead to the unknown. Many unsolved problems, and a tremendous amount of work lie ahead. In proceeding with the project, all of us hope that we will bring this research and development program to a successful conclusion.

The CHAIRMAN. Dr. Shoupp, your statement is somewhat enlightening. I believe you are the first witness to appear before this committee and discuss, in a technical manner, the type of reactor that you are building and trying to get into operation.

Mr. Van Zandt?

Representative VAN ZANDT. Doctor, where is this project located?

Dr. SHOUPP. The technical work on the project is being done at the laboratories of the Westinghouse Electric Corp., in Pittsburgh, Pa.

Representative VAN ZANDT. Why did you select this type of a reactor?

Dr. SHOUPP. The reactor appeared to us, after our original investigation, to offer prospects of economic nuclear power.

The prime interest to us that led us to this speculation was the reduced fueling cost for this type of reactor, since it avoids the fabrication of the solid-fuel elements.

Representative VAN ZANDT. Can you give us some figures on the cost?

Dr. SHOUPP. Well, I wish that I could. This is just what we are in process of determining in our phase I program. Our phase I program is set up to do enough preliminary design and analysis to enable us to get these preliminary costs.

Now, we work on cost data every day, but we do not have enough of them to add up to provide a cost number.

Representative VAN ZANDT. Can you make a guess, comparing on a percentage basis, the cost of the slurry of uranium as fuel, as against the solid fuel?

Dr. SHOUPP. Well, now, some of the uncertainties in these fueling costs are just the way that the uranium itself would be handled. You remember, here, that we have a mixture of uranium and thorium in this machine, and we start out with a large amount of highly enriched uranium. As time goes on, we burn this highly enriched uranium and make uranium 233 from the thorium. So the cost of the thorium and uranium and the credits for uranium 233 are very difficult for us to determine. But we hope—and it is our objective, not necessarily realizable—to obtain a breeding ratio of 1. This means we hope to create as much uranium 233 as uranium 235 we destroy or burn up in the reactor.

If this is the case, our primary costs will be the costs for rental of fuel. Costs for heavy water that we use in this reactor, of course, would also enter in. But the fueling costs should be comparatively low. Added to this is an unknown that we are trying to get our teeth into at the moment; namely, the operation and maintenance costs for such a plant and for such a reactor. This is something we just do not know at all now.

The CHAIRMAN. You feel that your process would be cheaper to operate than one where you have to reprocess the solid fuel; is that right?

Dr. SHOUPP. Yes. We will still have to reprocess the fuel in this type of plant. However, herein is one of the big advantages of this type plant. We hope to be able to do the reprocessing on site. Now, we are studying the feasibility for shipping the burned fuel away and reprocessing it, but it appears to us at the moment that the reprocessing plant should be located on site.

The costs of doing the processing are very difficult to come by, because they vary enormously with the size of plant as well as with the many technical considerations involved. These reprocessing costs for this type of plant, even though they are, I think, much simpler than in the solid-fuel case, are still unknown.

The CHAIRMAN. Where do you test your fuels?

Dr. SHOUPP. Where do we do the testing of our fuels? Under irradiation, sir?

The CHAIRMAN. Yes.

Dr. SHOUPP. Well, under irradiation, to my knowledge, no one has yet operated a flowing slurry loop in a reactor. We work very

closely with the Oak Ridge National Laboratory and we are planning to put into the Oak Ridge Research reactor the first flowing slurry loop as a joint project with the Oak Ridge National Laboratory. I would like to ask Dr. Johnson precisely when the loop is to go into service.

Between September 1 and January 1, I believe, we will have the first operating slurry loop in a reactor.

Now, the tests other than radioactive, which are probably more complicated than in the radiation case, are being done on the slurries in our own laboratories in Pittsburgh. And a very large amount of effort is going on at Oak Ridge. However, the primary Oak Ridge effort is on the two-region homogeneous reactor, and our work emphasizes the one-region reactor. There is a considerable mutual interest and a mutual crossflow of information. But we are doing quite different jobs that only partially overlap.

The CHAIRMAN. Are you receiving full cooperation from the Laboratory?

Dr. SHOUPP. We are receiving excellent cooperation at the Oak Ridge National Laboratory.

Representative VAN ZANDT. Doctor, can you got into a little more detail as far as phase I is concerned?

Dr. SHOUPP. Yes. Phase I is to determine the feasibility of continuing the detailed engineering and construction of the final plant.

At the end of phase I, we would expect ot be able to make roughly the following remark: that we have now determined that the plant can, or cannot, be engineered at that time. We will not know the solution to all our problems, but we know what the problems are, and we know that we can solve them.

The CHAIRMAN. You are not in a class alone.

Representative VAN ZANDT. The reason I asked the question, Doctor, was because I think you are making a very intelligent approach to this overall problem.

In regard to the financing, based on what you have said in your statement: $5.5 million has been made available for 1958, or to 1958.

Dr. SHOUPP. Ending in 1958.

Representative VAN ZANDT. Do you have any program of financing the program for 1958, and beyond that year?

Dr. SHOUPP. Well, if the answer to phase I has been determined favorably—and it may come early in 1958, or it may come later—we then have plans for financing further development of this type of plant.

Possibly Mr. Busby would like to comment on that, from the Pennsylvania Power & Light Co. standpoint.

Mr. BUSBY. Well, we are in the process of trying to determine through phase I what is the basis of future action. And certainly, as Dr. Shoupp has said, if the results of phase I, whenever that comes to its concluding point, are satisfactory, then that provides us with a basis for evaluating the program and, I should think, going ahead with the program.

Representative VAN ZANDT. Based on present-day costs, can you give us an ultimate cost of the plant?

Dr. SHOUPP. Well, again, this is just the information we hope to get a reasonable estimate for at the conclusion of phase I of the pro-

gram. I can certainly say that it will be more than for a conventional plant. But the big unknown here that is, in my mind, more important than many of the other unknowns is the cost of the maintenance equipment for such a plant. And you cannot get the costs on this until this equipment has been developed and all the plant arrangements and the concrete designs laid out. This we just have not done yet. So I just have no cost numbers that are good.

Representative VAN ZANDT. That is all, Mr. Chairman.

Senator ANDERSON. Can you go into further detail on your timetable? When you say that phase I is going to be finished sometime early in 1958 and you hope to have the plant running by 1962, are there any intermediate steps which might be taken to assure that, in the event phase I fails, there will be other orderly development?

Dr. SHOUPP. I want to emphasize again that the phase I program is really more of a fiduciary point that indicates when we have spent $5½ million than it is anything else. It is the time when we sit back and evaluate whether or not we should go further with the plan. This will probably occur early in 1958.

Senator ANDERSON. Then you have no definite plans for construction beyond that date?

Dr. SHOUPP. No. We cannot now say that a plant should be constructed of this type by anyone beyond; this is why we are spending our money to find out.

Senator ANDERSON. I think it is wise for companies intending to build plants to be sure before proceeding with construction.

I notice you say in your detailed testimony on page 16, that:

> The currently estimated costs for this type plant are running appreciably higher than the original estimates.

Can you define "appreciably"? Does that mean 2 percent, 10 percent, 20 percent, or, as in the case of some of these other concerns, between 33⅓ and 50 percent?

You see, a tenth of 1 percent would be appreciable, but it would not be significant.

Dr. SHOUPP. I would hate to classify any of our previous cost examinations as good estimates. A better word probably would be "guesstimates." And the cost analysis that we are referring to here is a preliminary look in the early days of our study work under this project. At that time we were estimating what power costs might be from plants of this type.

Senator ANDERSON. I am not trying to get at power costs. These are plant costs. If you are to attempt to budget something, you naturally must know how much it is going to cost. You say here that "the currently estimated costs"—you must have a figure for that—"are higher than the original estimates." Can you give me the original estimates, and something about the current estimated cost, in dollars?

Dr. SHOUPP. I was trying to recall some of our old costs.

Senator ANDERSON. Well, working backward, what are your current costs?

Dr. SHOUPP. Again, we are trying to get this idea of capital costs pinned down through the phase I part of the program. I have no good numbers that I would like to respect, in my own regard, on the cost of the plant.

Senator ANDERSON. If you do not know the current costs or the past cost, how can you tell which are higher?

Dr. SHOUPP. That is a very good point. All costs for powerplant components have gone up just due to normal escalation in the last year or two. Our estimates on these original costs that led us to the conclusion that a homogeneous plant was a good one to look into was made some time ago. And if I were evaluating increases in cost, I would then have to start separating out that that is due to normal price increases and that due to our incorrect original evaluation.

Senator ANDERSON. Do you mean to say, here, that it is estimated this plant will be finished by 1962, although you have not yet made a business decision as to whether to begin construction and, further, that you do not have any idea whether it will cost $1 million or $100 million?

Dr. SHOUPP. We have roughly, ideas as to what the plant would cost.

Senator ANDERSON. Then can you tell the committee what the currently estimated cost is, or is that figure classified?

Dr. SHOUPP. No, it is not classified.

Senator ANDERSON. Well, what is the estimated cost?

Dr. SHOUPP. I am very uncertain about the number, because at the moment we are trying to get hold of these numbers. We have asked our vendors for quotations on many of the components.

Senator ANDERSON. Are you ready to ask a vendor for a quotation when you do not yet know what you want to build?

Dr. SHOUPP. I can ask him "If I did want to build this" roughly what it would cost. And his guess on a component that he might supply would be a lot better than my estimate, and therefore I could use it in building up my cost estimate, as to what I would hope to come out with at the end of phase I.

The important thing that we went into on this project was that the fuel costs were going to be comparatively low (if we were successful in the development) compared to a solid fuel case. So we could stand additional capital costs over a solid fuel element reactor type, over and above that, and justify it on the basis of lower fueling costs.

Senator ANDERSON. But you do not have, then, any currently estimated costs to which you refer on page 16?

Dr. SHOUPP. I do not have a good cost estimate.

Senator ANDERSON. Nor do you have any original costs to which you refer?

Dr. SHOUPP. We have made some original estimates of cost.

Senator ANDERSON. What were those?

Dr. SHOUPP. I do not recall them now.

Senator ANDERSON. If I were to build a house, and somebody said the cost would be "about $50,000," and I decided I could not then build it, and 2 years later you came to me and said, "About how expensive was that house you were thinking about?" I would not say, "I haven't the faintest idea. It was between a dollar and a hundred thousand dollars." You must have had some costs in mind.

Dr. SHOUPP. I was trying to recall them.

Do you recall them?

Mr. BUSBY. Senator, there is no mystery about this except our own lack of information.

Senator ANDERSON. Let me try to find out: Is there any decision as to what these items will cost which should not be given in this hearing?

Mr. BUSBY. Let me try to explain, if I may. I think the particular matter you referred to referred to a detail of the plant.

Senator ANDERSON. I only read the words of it. It says:

> As a consequence the currently estimated costs for this type of plant are running appreciably higher than the original estimates.

If I say it is hotter today than it was yesterday, that involves a knowledge of how hot it is today and how hot it was yesterday. And if you have currently estimated costs, I would like to have them. If you have original estimates, I would like to have them. If you do not have them, I wish you would say so. If there has been, as I just suggested, a decision that actual figures would not be used in this hearing, reference to that decision would simplify matters.

Mr. BUSBY. What I would like to do, if I could, is to lay the situation right before you and the commiteee here, because our purpose in coming down here was to inform the committee as candidly as we are able to exactly where this project stands.

Now, on the matter of costs, the difficulty of comparison is that when we started this project we, of course, had no basis of cost knowledge. Now, we picked some figures out of the air. Take, for example, some of the information that was in the McKinney report. Well, that had ranges of costs, about what capital cost per kilowatt might be and what fuel cost might be in terms of mills per kilowatt-hour, and operation and maintenance. Well, that is generally speaking the rough background of information we have.

Now, since that time, we certainly have taken those general sorts of figures, and have found, in terms of our own experience, that we are talking about costs which in certain areas, certainly, seem to be higher.

Now, for example, we know, certainly—this is in a general education sense; I want to use the word "know" very loosely, because phase I is intended to bring us knowledge which we do not have. We have general indications that certainly the capital cost of this plant will be very substantially higher than the capital cost for a conventional plant; that operation and maintenance costs for the nuclear plant would certainly be higher than for the conventional plant. And as regards fuel costs, right today the general indications are that the fuel cost of a conventional plant would not be far removed from the fuel cost for the plant we are talking about.

Now, in talking of nuclear fuel cost, I am using a composite figure, which embraces the cost of the U–235, the cost of the heavy water, the credits, the carrying charges, and chemical processing of fuel. And as a very general measure of what we are talking about, we would say today, subject to all of the necessary qualifications, that it looks to us as if total power costs would be in the range for this plant—and this is subject to many qualifications of lack of knowledge—somewhere from 11 to 16 miles per killowatt-hour.

Senator ANDERSON. We were talking about the construction cost of the plant.

Mr. BUSBY. Well, certainly, Senator, we are in the process of testing with venders their prices on equipment. We know the bricks and mortar have gone up.

To get a price on the plant, of course, it has to be in rough design. And we are in process of getting that rough design and testing prices, and I would certainly think it a fair assumption that if we had had the same information in 1955 that we have today, and made cost estimates in 1955 and cost estimates today on the same factual basis, certainly we would find that our cost estimates today would be higher.

Senator ANDERSON. Well, I will try once more, and then I will promise to stop.

Do you have a currently estimated cost of the plant which you refer to?

Mr. BUSBY. We could give you a figure. We could say, for example, that we have talked of the possibility of $300 a kilowatt.

Senator ANDERSON. Then let us put it this way. I read in a publication a short time ago that the failure of Congress to pass legislation for idemnity insurance was holding back the program. So I may safely conclude from your testimony that it is not holding back your plant; is that right?

Mr. BUSBY. Mr. Oakes so testified, and we would say the same thing as far as our program here is concerned right here in February 1957.

Senator ANDERSON. Because if you have not yet made up your mind what the plant may cost or whether you are going to build it, and you have not made a decision on phase I, and are going to have to wait until 1958 to decide where you are going to go, then you are not being held back by the absence of an indemnity plan, are you?

Mr. BUSBY. We may not have made progress by your standards, but Westinghouse and ourselves went into this program to do the very best possible job.

Senator ANDERSON. Let us answer the question. If you do not have even a decision that you are going further than phase I, then you are not being held back by the absence of an indemnity program, are you?

Mr. BUSBY. We have never said we are.

Senator ANDERSON. Nor have I said you were. But there is a great deal of talk about this; that we must pass this quickly so that we can get in operation. As far as you people are concerned, it is not holding you back.

Mr. BUSBY. No, sir. But I certainly would not fail to say that adoption of such legislation would be otherwise than reassuring to the industry as a whole and to our project. It certainly would be reassuring. I am not saying we are held back by the absence of it.

Senator ANDERSON. I have just been reading a book about the dirigible, called Ships in the Sky. If I do not plan to build and fly a dirigible myself, is the question of insurance going to concern me?

Representative PRICE. I wonder, Dr. Shoupp, if you would explain to the committee just how your cooperative program on the reactor at Oak Ridge works? How do you proceed to follow that program?

Dr. SHOUPP. The best man to answer that, I think, is the man that has to bring this cooperation about. Dr. Johnson is manager of the project, and I would like to ask him to explain how he cooperates with Oak Ridge and how they cooperate with us.

Representative PRICE. Could you explain that to us, Mr. Johnson?

Mr. JOHNSON. It is done in many ways. When we initially started the program, it was done pretty much by our taking trips to Oak Ridge, talking to the people there, by carefully reviewing and evaluating the reports from Oak Ridge National Laboratory, which we get through our access permittee agreement. The situation has somewhat changed today to where we now have a two-way flow of information rather than a one-way flow. We not only make trips to Oak Ridge but I would say we probably have 2 trips a month to Oak Ridge and Oak Ridge makes 1 or 2 trips a month of their technical people at Pittsburgh.

The first real cooperative program we have set up is this inpile test program. We have made in the PAR project considerable progress in designing and constructing an inpile circulating slurry loop. We initially designed this to fit the slurry conditions for a single region reactor, which are quite different from two-region reactor.

By sitting down with the Oak Ridge people, we have both modified our programs to where we are now designing this loop for an intermediate concentration slurry halfway between.

Representative HOLIFIELD. Will you please explain, for my benefit at least, what you mean by a one-region and a two-region reactor?

Mr. JOHNSON. Yes. The HRE No. 1, the first experiment at Oak Ridge, experimental reactor, was what we call a simple burner. It is a solution of uranyl sulfate. It uses pure U–235. The reactor now under construction is called a two-region reactor. It consists of this central core region which is really a simple burner like HRE No. 1, and surrounding that is a circulating slurry of thorium. This is what we call a very heavy slurry. It is about a thousand grams of thorium oxide per kilogram of water. So, you see, we have two regions, a core region and a blanket region.

The single region reactor really combines these into one large mixture. We make a mixture of thorium oxide and uranium oxide and put it in one large vessel. And here it is a much larger vessel, but the concentration of the slurry is much less. It is about 300 grams of thorium oxide and uranium oxide mixed per kilogram of water.

Representative HOLIFIELD. I noticed the high degree of heat, 600°, I believe.

Mr. JOHNSON. This would be true for both reactors.

Representative HOLIFIELD. It would? And at what point would you take your heat off? And how?

Mr. JOHNSON. This is a circulating fuel. Both types are circulating-fuel reactors. The fuel is heated in the reactor vessel. It is then circulated through a cooling loop to a heat exchanger, and the heat is then transferred to water, which is formed into steam going to the turbine. So our whole primary system is a circulating-fuel system.

What we are now proposing to do with Oak Ridge is to design this loop for an intermediate-concentration slurry, so the results will be of interest to both the single-region and the two-region reactors. We are now designing the loop. We are fabricating it and setting it up. In fact, part of it is in operation now. The Oak Ridge people are designing the facilities that are needed at the reactor itself. We will then ship our loop to Oak Ridge. We are proposing to supply about

20 percent of the operating personnel, and they will supply about 80 percent.

Representative HOLIFIELD. At Oak Ridge?

Mr. JOHNSON. At Oak Ridge. So it is a true joint program, where the results will be of benefit to both reactors.

Now, as our project is getting larger and we are developing more information, there is more 2-way flow of information between the 2 groups. All of our reports we automatically send to Oak Ridge National Laboratory. We in turn get their reports back through TIS.

Representative PRICE. Do you have any technical people at the present time working at Oak Ridge on the homogeneous-reactor project?

Mr. JOHNSON. Yes. I might say we, at Westinghouse, have always had at least one man at Oak Ridge on the loanee program. The original man was an OSORT graduate. He came to Westinghouse and we sent him to the OSORT school. He then got into the homogeneous-reactor program and stayed for 2 years, I believe. He is now back at Pittsburgh, and we replaced him roughly a year ago with another of our engineers. Pennsylvania Power & Light Co. has two engineers on the operating crew of the HRE No. 2.

Senator ANDERSON. Thank you very much. I want to say this to you: I asked you many questions. But I deeply appreciate the fact that your company has come in and talked about this project and, I think, talked about it very intelligently, and I want to compliment you for so doing.

Dr. SHOUPP. Thank you, sir.

Senator ANDERSON (presiding). Mr. Biemiller.

STATEMENT OF ANDREW J. BIEMILLER, LEGISLATIVE DIRECTOR, AFL–CIO, ACCOMPANIED BY SEYMOUR BRANDWEIN, SECRETARY, AFL–CIO STAFF COMMITTEE ON ATOMIC ENERGY

Mr. BIEMILLER. Mr. Chairman, for the record, my name is Andrew J. Biemiller; I am legislative director of AFL–CIO, with offices at 815 16th Street NW., Washington, D. C. I am also chairman of the staff committee on atomic energy of that organization. I am accompanied by Mr. Seymour Brandwein, an economist in our research department, and the secretary of the AFL–CIO staff committee on atomic energy.

Mr. Chairman, I appreciate this opportunity to appear on behalf of the American Federation of Labor and Congress of Industrial Organizations. Organized labor is greatly interested in American atomic development, for we are all aware that such development can influence significantly the future well-being of our Nation and the entire world.

I will be brief, commenting on only a number of aspects of the Nation's nonmilitary atomic program. The several major points I wish to emphasize at this general hearing are these:

First, America's rate of atomic-power development is inadequate. The Government should undertake promptly a program of construction and operation of large-scale atomic powerplants for us to gain the practical experience and knowledge necessary if we are to provide effective world leadership in this vital field.

Secondly, with the rapid spread of industrial and other users of radioactive materials, there is an increased need for caution against the hazards of radiation to workers and the general public. There is also a need for adjustment of workmen's compensation laws to meet the special new problems raised by radiation injury.

Third, the Atomic Energy Commission is still dragging its feet in making public all the information to which the public is entitled on the Nation's civilian atomic plans and progress.

Finally, there is a need for a closer link of the AEC and labor and management in this country to handle more effectively a variety of peculiar atomic problems of specialized labor-management concern.

Let me elaborate briefly on each of these points.

ATOMIC POWER DEVELOPMENT

Probably the greatest concern in the country today, on the conduct of the atomic-energy program, is with the pace of development of industrial atomic power. The AFL–CIO is seriously disturbed at what we consider to be an unbalanced and inadequate rate of progress in the American atomic-power program.

Not enough attention has been given to the task of actually building and operating a variety of sizable atomic powerplants. This should be done rapidly. It should be made a high-priority national goal.

The urgency of such action is dictated particularly by international considerations. Atomic power has become a symbol around the world, a sign of opportunity to raise living standards. The world needs more plentiful power and is anxious to move ahead. Many nations are already allocating a substantial proportion of their resources to atomic development.

A dramatic example of the significance of the atom in international affairs is the fact that six western European nations, known for their discord rather than their cooperation, have just reached an agreement to pool their atomic resources in the so-called Euratom arrangement.

America's role as leader of the free world requires that it provide effective guidance and practical aid in the rapid development of atomic power abroad. If we go about this responsibility halfheartedly, we will lose a vital battle in the struggle between the free world and the Communist-dominated world.

Our course in the last several years has not been geared sufficiently to meet this need. Although the administration has sought to provide international aid by providing atomic fuel to other nations and making available technical information and training, it has not really put its shoulder to the job of getting atomic plants functioning around the world.

Our atomic policies have been influenced too heavily by consideration of domestic power needs alone, by the fact that short-run pressures for atomic power in this country are limited because power produced from conventional fuels is still cheaper here than is now feasible from atomic energy. We have, therefore, concentrated on technology, on experimental and small demonstration models, in the hope of finding less costly means of converting atomic energy to electric power.

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We have suffered, too, from the fact that, in opening atomic-power development to private enterprise, the Government also placed the major responsibility on private enterprise.

The policies of experimentation with technology and reliance on private enterprise have much to commend them, but, because the administration has gone whole hog on them, progress has not been soundly balanced.

There has been inadequate attention to the need for actual full-size plant experience, with the result that we lack economic and technical information that can be gained only from practical experience. We are hampered in our ability to provide immediate practical assistance to nations with high conventional-fuel power costs which want and need to construct atomic plants now.

In relying solely on private enterprise to take the initiative on atomic powerplant construction, the administration has been unrealistic. Private enterprise alone will not meet the need. Only one large atomic powerplant will go into operation in this country for several years, that at Shippingport, Pa., and that plant is financed principally by Government funds.

It should be emphasized that organized labor is a strong supporter of private enterprise and eagerly sought its participation in the development of peaceful uses of atomic energy. Before this Joint Committee in February 2 years ago I urged specifically that—

> the public interest can better be served by drawing upon the talents, creative vigor, and traditions of our private-enterprise system than by relying on a continuing Government monopoly in this field.

But encouragement of private enterprise should not mean an abandonment of Government responsibility for forward progress in this area. It is no insult to private enterprise to say that it does not now have adequate incentive to do the job necessary to meet America's international needs. Indeed, it is remarkable, in light of the difficulties in developing industrial atomic power, that private enterprise has moved ahead as much as it has.

The size of the investment required is so large, the engineering and other technical problems to be overcome are so uncertain and complex, the size of the program necessary to meet our international responsibilities is so large, that it is folly to rely on private enterprise alone to meet the need. This is particularly so in light of the doubtful profitability of large-scale atomic plants in this country in the period immediately ahead.

This is how the Government itself must undertake the responsibility of constructing several major atomic powerplants.

We can best learn how to build and operate atomic plants by actually building some. The sooner we start, even though today's plants are only model-T versions, the more quickly we'll gain the practical experience and knowledge necessary to meet our international responsibilities and to produce better plants.

The AEC has finally recognized the need for moving ahead to construct promising types of plants by announcing that if private industry does not come up with proposals to do so the Government will finally construct some itself.

Let us not wait any longer. Our decisions today will decide our practical atomic-energy abilities several years from now. There

should not be a policy of "either private enterprise or the Government." There is need for both to proceed.

The Government's moving ahead to construct several types of large- and medium-size plants should not mean dependence on Government alone. It need in no way limit or prevent private enterprise from acting at the same time.

There is one aspect of private atomic development which does give cause for great concern. We fear that, in encouraging the program of private development, the Government may not remain fully alert to the danger of commercial monopoly and to the danger of private companies benefiting unduly at the public's expense.

The Government has been encouraging combinations of companies to undertake atomic-power projects. In using such combinations, it must not lose sight of the fact that authorization of large combines raises a threat both (1) of leaving independent outfits permanently frozen out of any significant atomic business, and (2) of relaxing limitations on commercial combinations in this country.

The Government must not abdicate its responsibility to assure that private atomic development proceeds on a fair and fully competitive basis. There must be careful scrutiny of combinations and aggressive enforcement of the antitrust laws to prevent any group from gaining control of or unreasonable advantage in any part of such development.

The Government should continue to aid private firms in developing atomic power, but should not foot the bill without assurance of return to the public for its investment. The report released last week by the General Accounting Office showing that the AEC had entered into a contract to provide substantial financial aid to the Yankee Atomic Electric Power combinations without gaining adequate assurance on the combination's financial responsibility, its obligation to complete the project, or the costs involved, should serve as a warning of the need for vigilance.

INDUSTRIAL ATOMIC HAZARDS

Atomic development has been accompanied by a host of new and peculiar safety hazards. The record of control of these radiation hazards to date appears quite good. We have been heartened to see the excellent AEC effort on many problems of safety control.

One of the byproducts of the laudable record to date unfortunately may be an easing of the very precautions and concern which have warded off some of the dangers till now. The record of relatively few accidents or apparent injuries in the past testifies to the need for continued all-out efforts on safety and not to a relaxation of standards.

This is true particularly because, with the number of private civilian users of radioactive materials increasing rapidly, the responsibility for handling potentially dangerous radioactive materials and equipment may be in the hands of persons less familiar and less competent to control the hazards.

We are concerned about the signs of the AEC's intent to abandon some of its hazard-control program on radioisotopes to the different States. Commission representatives have indicated that they plan to turn over some of their safety-control obligations to State representatives, while seeking to achieve a "maximum degree of uniformity."

This would be a dangerous backtracking on the current program. Responsibility for enforcement of desirable radiation safety standards cannot be ceded to 48 State jurisdictions without leading to serious impairment of safety levels in many States.

The inadequacies of workmen's compensation legislation in the radiation-injury field in some States present another serious problem. Some of the State laws do not clearly cover radiation injury, for example. Others have statutes of limitations which do not allow for the fact that radiation disability may not become apparent until some time after exposure.

Mr. Chairman, may I request permission to add as an addendum to my statement a paper on the atomic hazards for workers, which I presented at the annual convention of International Association of Industrial Accident Boards and Commissions last December?

Senator ANDERSON. Without objection, it will be received.

(The information referred to follows:)

ATOMIC HAZARDS FOR WORKERS

(By Andrew J. Biemiller, chairman, staff committee on atomic energy of American Federation of Labor and Congress of Industrial Organizations)

It has been fashionable, in referring to atomic development, to say that atomic industry is a growing industry; that it will bulk large in the economy's future. This is indeed true, but it is no longer necessary to look to the future alone.

It is time now to recognize that atomic industry—the civilian use of atomic materials—is at least a small giant already and is a significant factor in today's economy. And from the standpoint of all concerned with safety and workmen's compensation, this infant giant presents problems to be met here and now and not merely questions to be reckoned with in the indefinite future.

There have, of course, been substantial atomic-energy operations for some years for military purposes, and to some extent, for peaceful development under Government auspices. These activities at major installations generally have been accompanied by utmost concern for the safety of employees. Top-flight specialists have been employed and urged to develop and apply all necessary safety precautions. Protective devices have been given top priority. Cost has not been a compelling limiting factor. In short, with little incentive to skimp on protection for financial reasons, the result has been what appears to be a good safety record.

But it is this very fact of a laudable record to date which harbors danger, for it may lull many into an unwarranted sense of security.

As private civilian uses widen, potentially dangerous radioactive materials and equipment may be supervised by persons less familiar with the hazards. They may be neither as alert to the hazards nor as competent to control them as the safety officials in the major Government-contract installations. Equally dangerous, there may be less inclination to be supercautious in the interest of workmen if significant expenditures are required for maximum protection.

In referring to the broadening civilian use of the atom, most of us think of power and of the various reactors now being constructed or planned to generate electric power. This has been the most dramatic and most publicized area of growth.

The powerplants do present the most serious safety questions and do involve relatively large concentrations of workers, but atomic uses already range far beyond electric-power generation. It is these less publicized areas that must also be borne in mind in citing the widened use of the atom.

Let us examine several brief statistics. First, in the nonindustrial fields, we know that atomic radiation is being applied increasingly for varied medical diagnostic and therapeutic purposes. It is being used as a research aid in ever more wide ranging investigations of biological and chemical processes. And hosts of experiments are underway in agricultural and food applications—in plant-breeding experiments, in more efficient fertilizer use, in pest control, in food preservation. Almost each day's newspaper reports on a new step forward or on a new research reactor at some university.

The records of the Atomic Energy Commission permit some quantitative measure of this nonindustrial growth. At the end of 1951, less than 500 institutions—hospitals and other medical organizations, universities, Government laboratories, and various foundations—were authorized by the AEC to procure and use radioactive isotopes. A little more than 4 years later, by mid-1956, the number had almost quadrupled to more than 1,900 nonindustrial users.

In the industrial sphere, the expansion has been even more remarkable as company after company has come to apply the wonders of radioactivity to hundreds of measurement, inspection and control purposes and to the changing of characteristics of various materials.

There were only 134 industrial firms in the country at the end of 1951 using isotopes of sufficient radioacticvity to require authorization (or licensing) from the AEC. In a little more than 4 years, this number has grown tenfold. As of May 1956 more than 1,360 industrial plants used radioisotopes.

In addition, most plants today use such isotopes far more extensively than earlier. Many which several years ago experimentally put but one type of isotope to use have advanced today, not merely to more intensive use of that isotope, but often to the use of a half dozen or more for a much wider range of applications. This is well indicated by the fact that the average shipment of isotopes to private users by the AEC rose in size almost 20 times between just 1951 and 1954.

The industrial users of radioactive materials are not confined to limited industrial areas. All areas of the country are joining in this development. Radioisotopes in quantities large enough to require licensing are now used by firms in 44 States, the District of Columbia, and Hawaii.

In each of 27 of these States there are now more than 10 users. And in each of 5 States there are already 100 or more industrial users of radioactive istotopes.

Different radioisotopes emit different amounts of radiation. Some raise little threat of injury. But most radioisotopes now in common use by industry are classified by the National Bureau of Standards as moderately or very dangerous and are used in amounts which require special safeguards.

I cite this background, not to be an alarmist, but in an effort to gain recognition that atomic energy is already current and not merely a future occupational hazard. It is only through such recognition that safety awareness can be developed to keep the hazards in check and to adapt the compensation laws to meet the special difficulties posed by the peculiar nature of radiation hazards and injury.

Such awareness has developed rapidly in the trade-union movement. A number of national unions representing sizable groups of workers in atomic activities have now assigned full time specialists to just this area. They are bending their efforts to development of broader understanding among their membership of the need for continuing caution in working with radioactivity.

The Boilermakers Union, the Pipe Fitters and Plumbers, the Oil, Chemical, and Atomic Workers, and the Machinists Union, the Auto Workers, the Electrical Workers, to name but a few, have each developed special informational and other programs in this area.

All the major national unions joined, in the first merger conference of the American Federation of Labor and Congress of Industrial Organizations a year ago this week, in adopting a special resolution on atomic energy. Among other items it directed particular attention to the need for development of, and I quote—"(1) Effective health and safety standards to meet the special hazard presented in work with radioactive materials (and) (2) provisions for fair compensation for workmen suffering radiation injury."

The AFL–CIO economic policy commitee has since established special policy and staff subcommittees on atomic energy, with the key responsibility being the furthering of these radiation safety and compensation objectives.

While details have not yet been made public, you maye be interested to know that in response to the concern of many unions in this area, and their desire for guidance and balanced evaluation of these problems, the AFL–CIO is planning to bring together sometime early next year for a special conference on radiation hazards the key officers and safety leaders of all interested trade unions.

Among the areas certain to be explored are (1) the special safety needs posed by the peculiar nature of radiation and (2) the adequacies of existing workmen's compensation legislation, and revisions which might be required, for meeting nuclear radiation problems.

I want to touch on these areas with you today. Why do we repeatedly say the "peculiar nature" of radiation hazards? Let me first list a number of reasons and then the types of safety problems will be come self-evident:

First: Radiation is invisible and indeed cannot be detected by any of man's senses. A man may be getting a severe dose of radiation and suffering serious injury without being at all aware of it at the time.

Because the hazard cannot be seen or felt, the risk cannot be avoided merely by reasonable care by the workers as in the case of most industrial hazards.

This explains the need for special radiation detection devices to provide regular and thorough checks of the amount of radiation present and makes clear the particular importance of shielding and special protective equipment as safeguards.

Second: Radiation hazards are widely varied. Without attempting to draw detailed distinctions, it should be noted that different types of radiation each have different penetrating powers and effects, that materials contaminated by radiation present still other problems, and that external radiation poses difficulties quite different than the threat of internal absorption of radioacive materials.

In short, there is no uniform set of precautions. Protective measures must be designed separately for each particular hazard situation.

Third: Radiation has a cumulative effect. The amount absorbed at any one time may not in itself be dangerous, but may prove seriously damaging in combination with earlier exposure, even though separate exposures may be years apart.

It is the total accumulated over the years that counts. There are apparently no recoveries or fresh starts. Any radiation absorbed by a worker reduces permanently the dosage he may be exposed to in the future. This underlines the importance of maintaining permanent exposure records for each affected worker.

Fourth: How much radiation may be absorbed without appreciable injury is not known for sure. Scientific groups have, on the basis of certain assumptions, recommended "Maximum permissible exposures," but they are quick to caution that there is only one truly safe rule: The less radiation the better.

There are other complications on exposure limits. Some people are apparently more radiosensitive than others. Also, different parts of the body have different sensitivity. A large dose which hits the less sensitive parts may not be very dangerous in comparison to a smaller dose to the entire body or particularly sensitive organs.

Fifth: And still another difficulty: Radiation injury may not be immediately evident. The reaction may be long delayed, with injury not apparent until even years, as many as 25 or 30 or more years, after exposure.

Sixth: Even more troublesome, ill effects of radiation may never become apparent or measurable, although they are nonetheless real. Overexposure may produce, not identifiable radiation disease, but rather increased susceptibility to certain diseases, most notably leukemia and other cancers. And it may also otherwise produce a general shortening of the life span.

In other words, excessive radiation can mean weakened resistance, which brings on death earlier than usual. The worker who absorbs a good deal of radiation may have no evident injury and ultimately may die from the very same causes as other persons—but sooner.

Beyond this, there is also the fact that some types of radiation threaten genetic damage, threaten not merely the worker himself but his children, his grandchildren, his great-grandchildren. Radiation may affect the reproductive cells and mean either sterility or, if an affected worker can have children and grandchildren that some might be malformed or retarded.

It is apparent that the peculiar characteristics of radiation raise problems not contemplated by existing workmen's compensation laws. The laws need change to assure that protection intended by workmen's compensation principles is in fact provided to those endangered by radiation hazards.

I must hasten to say that I do not anticipate a sudden or great rush of radiation compensation cases, particularly as the trade unions succeed in broadening efforts to develop necessary safety consciousness in this area. But even with a crackerjack education job and scrupulous observance of all precautions, there inevitably will be at least occasional instances of negligence or accident.

It would indeed be ironic if workers dealing with radioactive materials, workers who are in the most forward-looking and advanced industries, were to be deprived of adequate compensation protection because of backyard-looking or unintentional gaps in the legislation.

It is now some 30 years since the first eruption of the farmed radium posioning of the young women who painted luminous dials on watches. Various States took account of the radium hazard after its reality was demonstrated so tragically by these unwitting victims.

A similar threat of major tragedy is ripe again. This time we have ample forewarning and a plentiful backlog of experience. Will the laws be adjusted quickly to meet the newer problems of radiation or must we wait for tragedy to set the spark for revision?

I offer no blueprint or ideal formulas for such revision. But at least two obvious steps certainly seem in order immediately. It should be made certain that radiation injury is covered and that statutes of limitations are adjusted to take account of the delayed nature of many radiation effects.

There are still some States, nine I believe, which have schedule rather than full coverage of occupational diseases and which do not include radiation disease in their coverage schedule. Other States with schedules do cover it, but often with possibly ambiguous or limiting language which technically may exclude some radiation injuries.

A number of experts in this field have suggested that certain simple language would clearly cover all radiation injuries. Their suggested coverage phrase is "disease caused by ionizing radiation."

On the statute of limitations matter, most laws are wholly inadequate because they do not allow for delayed disability. Already in at least one case, in South Carolina, a worker who claimed radiation injury, and received a compensation ruling that such injury had occurred, had his claim dismissed because of the statute of limitations.

A couple of States have now acted to meet this problem by providing simply that the time limitation will begin to run, not from the date of exposure, but from the date the worker first has knowledge of his disability and its nature.

On the more complex radiation problems, let me only note briefly at this time, by way of illustration, three noteworthy suggestions which have been made by different experts.

One suggestion arises out of the difficulties of measuring radiation effects or of linking a specific injury to a specific exposure. It may be desirable for this purpose to adopt a presumption provision on the causal relation between radiation disability and employment.

Such a provision would state that, if a worker is employed where radioactive substances are used, it shall be presumed, in the absence of substantial evidence to the contrary, that disability or death found attributable to the effects of radiation arose out of and in the course of his employment.

A second suggestion considers another aspect of the measurement problem and the delayed manifestation of injury. How do you apportion employer liability where the disabled worker may have been exposed in a number of different plants? It may be unfair to charge compensation against only the last employer and administratively impractical to divide responsibility among earlier employers.

Here it may be equitable to apply the second-injury-fund approach to reduce the cost assessed against the last employer.

The third suggestion is much broader and quite intriguing. Would it not be equitable to take into account the fact that radiation may harm a worker even though there is no immediate observable effect? Compensation might be provided at the time of overexposure in recognition of the premature aging, shortened life, delayed injury, or genetic damage which may be suffered as aftereffects.

Why not a uniform Federal system to provide compensation for different dosages of radiation suffered in employment, regardless of whether or not any ill effects are immediately apparent?

These and other problems and approaches require careful study. Several States have already initiated studies of needed legislative changes and they are to be commended for doing so. At the Federal level, the United States Department of Labor has also begun exploration of these problems in cooperation with other Government agencies.

But the wheels are turning slowly. Even at this late date, for example, no comprehensive examination has been made of the actual compensation treatment of the known or alleged cases of radiation injury. Surely such study should be undertaken by competent authorities.

The IAIABC has an especial obligation, as the organization of compensation specialist, to provide detailed guidance in this entire vital area.

The trade unions offer their utmost cooperation in getting necessary studies and discussion underway. Early decision and positive action must be achieved.

Let us follow through to gain adequate protection as soon as possible for all workers confronted with atomic hazards.

Mr. BIEMILLER. There are additional technical difficulties which we cannot well explore at this time, but the Federal Government should concern itself with this problem to assure that workers exposed to radiation hazards are not deprived of adequate compensation protection.

Organized labor is so concerned about this broad problem of hazards posed for workers and the public by the spreading use of radioactive materials that a special conference has been called by the AFL–CIO for all its affiliated unions to provide them with information, evaluation, and guidance on these hazards. The conference, to run for 2 days here in Washington, starts tomorrow.

A number of scientific authorities familiar with the technical problems in this field are meeting with the union leaders to help provide a fuller understanding of the types and significance of radiation hazards, the need for safety precautions for both workmen and the general public, and the problems involved in Government safety regulations and workmen's compensation legislation.

Two members of the Joint Committee, Senator Anderson and Congressman Holifield, have graciously consented to participate in this conference.

I am glad to submit as part of my statement a copy of the program for this 2-day conference of organized labor.

(The information referred to follows:)

PROGRAM, AFL–CIO CONFERENCE FOR AFFILIATED UNIONS ON ATOMIC RADIATION HAZARDS

(February 27 and 28, 1957, Mayflower Hotel, Washington, D. C.)

First day: Wednesday, February 27, 1957

9 to 9:30 a. m.: Conference registration.

Registration fee: $10 (includes both luncheons).

9:30 a. m. to 12:30 p. m.: Morning meeting, east room.

Chairman: Albert J. Hayes, president, International Association of Machinists.

Introductory remarks: Walter P. Reuther, chairman, economic policy committee, AFL–CIO; president, United Automobile Workers.

WHY RADIATION HAZARDS REQUIRE HIGH-PRIORITY ATTENTION OF TRADE UNIONS

"Widening Industrial Use of Radioactive Materials"—Dr. C. Roger McCullough, Deputy Director for Hazards Evaluation, Division of Civilian Application, United States Atomic Energy Commission; president, American Nuclear Society.

"Industrial Safeguards Against Radiation Hazards"—Dr. Carl B. Braestrup, director, physics service, Francis Delafield Hospital, New York; department of radiology, Columbia University.

Comments:

Fred MacGowan, international representative, International Brotherhood of Boilermakers.

Elwood D. Swisher, vice president, Oil, Chemical, and Atomic Workers.

12:45 p. m.: Luncheon meeting.

Chairman: O. A. Knight, president, Oil, Chemical, and Atomic Workers.

"Problems in Atomic Development"—Senator Clinton Anderson, vice chairman, Joint Congressional Committee on Atomic Energy.

2:30 to 5 p.m.: Afternoon meeting, east room.

Chairman: James B. Carey, president, International Union of Electrical Workers.

RADIATION HAZARDS AND THE PUBLIC INTEREST

"Concern of Local Community"—James G. Terrill, Jr., chief, radiological health program, Division of Sanitary Engineering Services, United States Public Health Service.

"Concern of the General Public"—Congressman Chet Holifield, member, Joint Congressional Committee on Atomic Energy.

Comments:

Benjamin C. Sigal, general counsel, International Union of Electrical Workers.

Joseph Philipps, apprenticeship coordinator, United Association of Plumbers and Pipe Fitters.

Second day: Thursday, February 28, 1957

9:30 a. m. to 12:30 p. m.: Morning meeting, ballroom.

Chairman: James A. Brownlow, president, metal trades department, AFL–CIO.

GOVERNMENT STANDARDS AND RESPONSIBILITIES

"Government Radiation Standards and Controls"—Dr. Robert R. Newell, professor of radiology, director of isotope laboratory, Stanford University School of Medicine.

"Workmen's Compensation and Radiation Hazards"—Prof. Earl F. Cheidt, St. Louis University.

Comments:

Donald Montgomery, director, Washington office, United Automobile Workers.

Andrew J. Biemiller, chairman, AFL–CIO staff committee on atomic energy.

12:45 p. m.: Luncheon meeting.

Chairman: Joseph D. Keenan, secretary, International Brotherhood of Electrical Workers.

"Labor's Stake in Atomic Energy"—George Meany, president, AFL–CIO.

2:30 p. m. to 5 p. m.: Afternoon meeting, conference room.

DISCUSSION GROUPS

Participants in the conference will be separated into different discussion groups to exchange information and suggestions on experience with radiation problems.

(The chairman of the discussion groups, each of whom is a member of the AFL–CIO staff committee on atomic energy, will at a later date bring the views expressed at these discussions to the committee as a whole for it to consider any necessary formal recommendations.)

Discussion group chairmen:

Jack Barbash, director of research, industrial union department, AFL–CIO.

Seymour Brandwein, secretary, AFL–CIO staff committee on atomic energy.

Paul Hutchings, director of research, metal trades department, AFL–CIO.

James E. Noe, director of research, Brotherhood of Electrical Workers.

PUBLIC INFORMATION

Mr. BIEMILLER. The atomic program's roots were in wartime military uses and military development proceeded under a strict cover of secrecy. The peacetime program is still plagued by a carryover of that background.

All information not of direct military value should be declassified. And the public should be given the information necessary for it to understand and assess our peaceful atomic course.

There has been progress to this goal, but the progress is still all too slow. Responsible scientific authorities still complain that secrecy regulations are hampering scientific exchange and progress without truly providing any necessary safeguard for military security.

There is still also a tendency to withhold from the public information which should be revealed, either because it is a bother to reveal it or because public knowledge might raise some embarrassing questions.

One notable example of the Commission's reluctance to proceed in the open and of its slowness to develop procedures for public review is the case involving the issuance of a conditional construction permit for a fast-breeder reactor at Lagoona Beach near Monroe, Mich. Without weighing at this time the technical or legal aspects of this matter, it should be noted that we have been greatly disturbed by the fact that the Commission acted here in a secretive and irregular manner and withheld from public examination certain information, some of which has subsequently been released, and concerning which there is no military reason for secrecy.

LABOR-MANAGEMENT ADVISORY COMMITTEE

Finally, we want to repeat the call we have made each year for the establishment of a statutory Labor-Management Advisory Committee to the AEC. Regrettably, the fulfillment of this need has been sidetracked each year.

Such a continuing expert private group is needed to focus on various complex problems arising out of peculiar aspects of atomic industry. The unusual health and safety problems, the security regulations, the collective-bargaining processes, and the vital manpower and special training needs are among the major examples.

In some part, the contributions from such a group have been sought through consultations with or studies by assorted ad hoc private groups. The potential benefits of a continuing, broad-based labor-management group have been lost.

We urge the committee to devote some time to a fuller exploration of this proposal. We firmly believe that the establishment of such a closer tie between the AEC and labor and management jointly can yield very substantial mutual benefits.

Mr. Chairman, in view of the short time now available, we have refrained from commenting at greater length on these and other aspects of the program. We will be glad to contribute our views in more detail on any of these matters as the committee might wish. We also hope to have an opportunity to participate in the committee's examination of particular problems later in this session of the Congress.

Thank you for the time this morning.

Senator ANDERSON. Thank you, Mr. Biemiller. We did consume more time than expected on the Pennsylvania Power & Light discussion; therefore we appreciate the concise manner in which you presented yours.

I wish to read into the record here this paragraph from the report on the bills a year ago, which sets forth a letter from the Atomic Energy Commission, May 18, 1956, saying that as a general proposition the Commission recognizes that construction of full scale proto-

type nuclear powerplants is a necessary and vitally important step in the development of economically competitive nuclear power and also recognizing that the construction and operation of such prototypes must be subsidized by Government or industry or both, inasmuch as they are not likely at this stage to be profitable.

Representative HOLIFIELD. On this intervention on the part of some of the labor unions as to the Lagoona Bay project, Mr. Biemiller, what has been your experience in dealing with the examiner, the special examiner appointed by the AEC, I believe, to hear this intervening petition?

Mr. BIEMILLER. Mr. Congressman, the actual interveners in that case are the United Automobile Workers and the International Union of Electrical Radio and Machine Workers. I understand they are testifying this afternoon, and I believe could handle that question more effectively and fully than I could.

Representative HOLIFIELD. I will withhold my questions on that, then.

That is all.

Representative PRICE. Mr. Biemiller, first I want to congratulate you on a very fine statement. I will say that I am in agreement with most of the thoughts expressed therein—possibly all of them.

I would like to ask you this question, since you have brought up the matter of the Lagoona Beach site for the Detroit Edison plant. In that case, as I understand it, the reactor safeguard committee made certain safety recommendations and raised objection to some of the safety factors in connection with this plant, is that not true?

Mr. BIEMILLER. That is my understanding.

Representative PRICE. You made reference to the fact that for a long time it was not possible for the public to be fully informed as to what these objections were.

Mr. BIEMILLER. As I recall the train of events, at the time that the conditional permit was issued the report of the Reactor Safeguard Committee was not made public. Due to the vigilant activity of several members of the Joint Committee, and due, I think in part also to the intervention of some of the unions affiliated with the AFL–CIO and due to a protest from President Meany to the Chairman and the members of the AEC, that report was finally made public. But it was some weeks before that was done.

We are raising the point that we believe that report should have been made public earlier.

I think you will also find, if you question the representatives who will appear this afternoon, that there are still documents which they consider essential to this case, which have been kept under strict classification.

Representative PRICE. Would you advocate that it be made the condition of a granting of a license for one of these plants that the safety recommendations of the advisory committee be met before such a license would be granted?

Mr. BIEMILLER. We, at a minimum, would think there certainly ought to be a full airing of the situation, and probably proceed as you have indicated.

Representative PRICE. You are familiar with the recourse open now to the decision of the Reactor Safeguard Committee. What is your comment on that?

Mr. BIEMILLER. May I revert to what I just told Congressman Holifield: that I am not familiar with the current day-by-day proceedings, and I think you can get a more accurate story on that matter from the UAW and IUE representatives.

Representative PRICE. Do you advocate that the findings of the Advisory Committee on Reactor Safeguards be made accessible to the public?

Mr. BIEMILLER. Yes, sir.

Senator GORE. In view of the conference on radioactive hazards to be held, I believe you said, tomorrow, I would like to inquire if you think it desirable, or perhaps necessary, for the Government to demonstrate safe as well as feasible means of generating atomic power?

Mr. BIEMILLER. Yes. I would answer "yes" to that question.

Senator GORE. I have been thinking more and more in recent months that as the hazard of radioactivity looms larger and more ominous, and with the promise of widespread construction, eventually, of reactors, this hazard constituted an impelling reason why the United States Government should proceed forthwith to build demonstration reactors for the dual purpose of accomplishing economic atomic power, and secondly, the development of safe ways in which to control the radioactive hazard.

Mr. BIEMILLER. We would concur heartily in your thinking, Senator.

Senator GORE. Well, has this problem loomed larger, or smaller, in the estimation of the American Federation of Labor in recent months?

Mr. BIEMILLER. We can give you a much fuller answer on that question, Senator, at the conclusion of our conference.

One of the things we are planning to do, after a day and a half of discussion with experts in various aspects of this problem, is to then convene our people into small discussion groups, where we are going to pool our experiences and our information. And we will be happy to make that information available to the committee. In general, I would say that we think that the problem is getting more serious as time goes by.

Senator GORE. Thank you, Mr. Chairman.

Representative VAN ZANDT. Mr. Biemiller, on page 1, you say:

> Probably the greatest concern in the country today, on the conduct of the atomic-energy program, is with the pace of development of industrial atomic power. The AFL–CIO is seriously disturbed at what we consider to be an unbalanced and inadequate rate of progress in the American atomic-power program.
>
> Not enough attention has been given to the task of actually building and operating a variety of sizable atomic-power plants. This should be done rapidly. It should be made a high-priority national goal.
>
> The urgency of such action is dictated particularly by international considerations.

Yesterday, one of the members of the AEC appeared before us, Mr. Harold S. Vance, and this is what he said:

> I should like to emphasize again the sharp difference between the situation abroad and the situation at home and to point out to you that because of this difference a program suitable for other countries is not now suitable for our country and vice versa. Failure to recognize this simple fact is responsible, I believe, for some of the questions which have been raised about the adequacy of our domestic-power program. The plain fact of the matter is that we need 2 programs instead of 1. We need one for ourselves and one for our foreign friends, each tailored to fit a different state of circumstances.

Would you agree with Mr. Vance's statement: that we actually need 2 programs, 1 to fit our needs and 1 to fit the needs of nations abroad?

Mr. BIEMILLER. Mr. Congressman, if you will go further down on page 2, you will note that we state "our atomic policies have been influenced too heavily by consideration of domestic power needs alone." Without commenting on the details of what Mr. Vance said, I would say "yes," that we would basically agree that there is a dual problem here.

Representative VAN ZANDT. In other words, you are not satisfied, then, with the program that we have domestically, nor are you satisfied with the program that we have for nations abroad?

Mr. BIEMILLER. Quite. I would agree with that.

I might say that Mr. Brandwein has just returned from a meeting of the Atomic Energy Committee of the International Confederation of Free Trade Unions, and he had the opportunity to check into some of the European problems, and we are quite concerned about this matter. I think President Meany will have something to say on this subject next Thursday at our conference.

Representative VAN ZANDT. That is all, Mr. Chairman.

Senator GORE. Mr. Biemiller, can the domestic interests of the United States be set aside, as one problem, separate and apart from the interests of the United States in the development of atomic power in other nations?

Mr. BIEMILLER. Well, I was assuming, in commenting on the remarks of Commissioner Vance, that he was taking broadly the same position that we have stated in our paper in general terms, that we recognize that it is probably true that in terms of the immediate foreseeable future, atomic plants would not be economically competitive with conventional fuels or hydropower in this country. But certainly in the immediately foreseeable future we have to be prepared to go into the international market, and out of that experience we would be developing the long-range technology which would be adaptable to the domestic scene. To that extent, I would agree that there is a fusion. But I think there is a short-range and a long-range program. And it was in that sense that I was interpreting Commissioner Vance's remarks.

Senator GORE. Well, Mr. Biemiller, are we not inclined sometimes to fall back upon generalizations about atomic power being uneconomic in the United States. We must remember that there are both low-cost power areas and high-cost power areas within the United States. I am not at all sure that economic atomic power is not possible in New England, for instance, right now.

Mr. BIEMILLER. I was going to say exactly the same thing myself. You are probably right; that if you think of the New England area, in terms of the present state of technology, atomically generated electric current would be economically competitive.

Senator GORE. Well, there are, of course, other areas of high-cost power within the United States. So it might be too easy to yield to too much generalization, even with respect to our domestic power needs. But be that as it may, I cannot separate the interests of the people of the United States measured by their domestic power needs and the necessity for the United States to maintain leadership in the vital field of nuclear power.

Mr. BIEMILLER. We would certainly say, Senator, that the broad principles of the Gore-Holifield bill of the last session tried to bring these two points together. I think some folks lost sight of the fact that the Gore-Holifield bill would have laid the foundation for getting the necessary technology and other knowledge that we need for our foreign enterprises as well as our domestic, and I presume it is in that kind of thinking that we would concur with you, following your line of thought.

Senator GORE. I appreciate your generous references. I can go along with your thought that the domestic power needs are less pressing than the demands of international relations and the preservation of our historic and traditional economic international relations. The one may be more pressing than the other.

Mr. BIEMILLER. I must admit I, for example, have been a little confused by the statement of about a year ago, as I recall, in connection with the Gore-Holifield bill, by certain officials of the AEC, that to start that type of program would be difficult, because there was not a sufficient supply of scientists and technicians available, and then to note that recently we have agreed we will help the European countries with Euratom.

Now, I am pleased that we are planning to help the Euratom project. I think this is one of the definite responsibilities that America has if it is to maintain its leadership of the free world. But there certainly was a contradiction in saying there was not a sufficient supply of technical and scientific skill for the Gore-Holifield program and to turn around and say we have the technicians for Euratom. Those two things can certainly be combined.

Senator GORE. It seems to me that the way to develop manpower and technical skills in this area is to go about doing it.

Mr. BIEMILLER. Right.

Senator GORE. As you say, we are now committed to give technical assistance to Euratom in the construction of large-scale reactors. We have not a single official in the United States who has had actual experience in either the construction or operation of a gas-cooled reactor. We have no one in the United States who has had experience in the actual operation of any sort of an intermediate sized atomic plant or large scale atomic powerplant. The only people in the United States who have had experience in the construction of large-scale reactors are those who have participated in construction of the Shippingport reactor, and it has yet to be proven successful. So just what kind of technical assistance are we to provide in the actual construction and operation of large scale atomic powerplants?

These are technical skills which, as you have said, we must gain through technical experience. In this field we learn by doing, as we do in all fields, particularly in all new fields. Now, if the course has been charted, if there as those who have had actual experience in the field, then they can teach others. But we have no one with that experience. Therefore, we must learn by experience. And the Atomic Energy Commission itself, as Senator Anderson has pointed out, has repeatedly said that actual experience in the construction and operation of large scale atomic powerplants is necessary to the development of technology. And as yet we have no such experience.

Mr. BIEMILLER. This is precisely the reason that we supported the Gore-Holifield bill and will continue to support that kind of legislation.

The CHAIRMAN. Any further questions?

Representative PRICE. Will you tell us something about the difficulties you have been having in getting amendments to workmen's compensation laws throughout the country?

Mr. BIEMILLER. To the best of my knowledge, there are only two States in the Union that have anything approaching an adequate workmen's compensation law today so far as proper protection as to radiation hazards is available.

Representative PRICE. What two States?

Mr. BIEMILLER. New York and California.

Representative PRICE. Were those recent recognitions, or were they in the law before we began the atomic era?

Mr. BIEMILLER. No. Those are fairly recent.

Now, let me give you a concrete illustration of the reverse kind of situation, of the kind of thing that bothers us. There is a recent decision in the State of South Carolina, in which, after all, atomic development is no small problem today, in which a worker was judged to have received a serious occupational disease from radiation. But the second part of the decision was that compensation was not available, because the statute of limitations had run its course. Now, that is the kind of concrete problem that we are trying to get at. We won't know, of course, until the end of the sessions of the 44 legislatures that are now in session as to what progress is made. But there are still, over and above the statute of limitation problems, some 9 or 10 States that do not even recognize radiation disease as a compensable item under workmen's compensation laws.

Representative PRICE. Would you say that in a good number of the general assemblies now in session there is consideration being given to providing for radiation accidents in their compensation laws?

Mr. BIEMILLER. I cannot answer that question accurately. The information is coming in to us at the moment. But, offhand, I recall noting only half a dozen in which some attention is being given.

The CHAIRMAN. Thank you very much, Mr. Biemiller.

Mr. Clyde Ellis is the next witness. Mr. Ellis is our former colleague in the House. We are glad to have you here with us this morning. I note that you have a summary, and you have a lengthy statement. Do you just want to read the summary and put the rest of your statement in the record, or how do you wish to proceed?

STATEMENT OF CLYDE T. ELLIS, GENERAL MANAGER, NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION

Mr. ELLIS. Mr. Chairman, I understood you required a summary. I would prefer to present the entire statement, but of course I am at the command of the committee.

The CHAIRMAN. You may proceed, then, on that basis.

Mr. ELLIS. My name is Clyde T. Ellis. I am general manager of the National Rural Electric Cooperative Association. NRECA is a national service organization representing 92 percent of the operating rural-electric systems. These systems serve about 3,800,000 farm families and rural establishments in 43 States and Alaska.

Most of the nearly 1,000 rural-electric systems in the country are distribution systems only, and don't have their own sources of power. The rural-electric systems are currently paying in excess of $150 million a year for wholesale power. Their use of wholesale power is doubling every 4 to 5 years, and more than one-fourth of them are in difficulty on their wholesale supply one way or another.

The members of this committee are aware of the continuing interest the rural-electric systems have had in the atomic-energy program. In each of our 10 regional meetings held last fall, covering in the aggregate all the States, at least 1 resolution was passed concerning the atomic-energy program. And in all of these resolutions there is one common request—that the atomic-energy program be speeded up. More specifically, these resolutions urge that:

(1) Congress appropriate funds for the Federal construction of the necessary atomic powerplants to act as a yardstick on costs;

(2) Private and public agencies do everything in their power to lend their aid and assistance to the speedy attainment of production of electricity from atomic energy at low costs; and

(3) Congress direct the AEC to construct civilian atomic powerplants of different types and sizes in order to accelerate the civilian atomic-power program which is stalled on dead center. This authorization would be similar to the Gore-Holifield bill.

In addition, several of the resolutions adopted stress the fears that existing policies threaten to transfer control of this invaluable treasure to a few great corporations without properly safeguarding the public interest, despite the fact that for all practical purposes the entire program has been financed by the Federal Government.

I'm sure we need not dwell long on the point that our economy, as well as the economies of all other industrialized nations, is based on a low-cost source of energy. Improved living standards in our own Nation, and in underdeveloped nations, can come about only through the increased use of low-cost power. It has been demonstrated that there is a high correlation between the per capita income of the Nation and the per capita consumption of electrical energy. Nations with a low per capita income have a corresponding low per capita consumption of electricity.

Any assumption made to the effect that we can continue to increase our standard of living without an ever-expanding supply of low-cost energy is by definition fallacious. This is particularly true as long as our economy is so heavily burdened by the cost of war and cold war.

The great hope, it seems to us, is nuclear power. The problems—and we fully recognize they are not small ones—are to speed the development of nuclear technology and to see that the fruits of this technology are neither delayed by short-run private financial requirements nor blighted by private monopolistic restraints of whatever kind, for whatever purpose.

PROGRESS IN THE UNITED STATES ATOMIC-ENERGY PROGRAM

It appears to us that we can measure progress in the atomic-energy field in terms of:

(*a*) The economic resources employed in research into the technology and feasibility of developing the atomic-energy program, viewed

against the background of public policy—the adequacy of the law, adequacy of finance, and the vision and responsibility manifested by those responsible for administering and promoting this program so vital to the national welfare;

(*b*) Concrete plans for construction of commercial power reactors backed by firm financial commitments;

(*c*) Commercial power reactors actually under construction: (1) by any producer or manufacturer; (2) by Government to ascertain accurate costs and a yardstick;

(*d*) Commercial power reactors actually in operation.

Naturally, all these indicators should be measured by the variety of reactor types and sizes multiplied by kilowatt capacity.

It is easier to discuss these progress indicators in reverse order.

As regards the number and variety of commercial power reactors actually in operation, the answer is short and simple—"none," but the Argonne Laboratory 5,000 kilowatt boiling water reactor, if it is to be counted as one.

As regards the commercial power reactors actually under construction, we are informed that there is only one which we can actually say has progressed to a stage where completion seems assured. (Possibly the General Electric 5,000 kilowatt boiling water reactor and the North American Aviation 10,000 kilowatt sodium graphite reactor will also go into operation this year, but they are small ones.) This is the 60,000 kilowatt initial capacity reactor under construction at Shippingport, Pa., and, as you know, this reactor is being subsidized nearly 100 percent by the Federal Government, considering both the direct AEC subsidy and the indirect accelerated tax amortization benefits.

In reference to plans for commercial reactors backed by firm commitments, we have heard many rumors and have been informed of many private utility combines banding together to engage in the construction of nuclear reactors, such as the Power Reactor Development Co. and the nuclear-power group, the Florida group, Carolina power group, et cetera, but all of these proposals are still more or less in the formative stage and we cannot count them as being actualities until real construction has been under way.

Senator GORE. You mean real construction, or digging a hole in the ground?

Mr. ELLIS. I mean real construction.

Senator GORE. Not a political ground breaking.

Mr. ELLIS. No, sir. That is very important, I think.

As regards our first indicator of the measure of progress in the atomic-energy field, I would like to make the following observations.

To all of us who are essentially "laymen" in the field of atomic technology, the adequacy of resources devoted to research can be measured only by the fruits of that research. This is true for many reasons but primarily because we do not seem to be able to cut through the conflicting, extravagant, and sometimes, I fear, even less-than-honest claims being made in this area.

Over the past 16 years the AEC, private industry, the universities and other agencies have accumulated a vast amount of technical data on the production of power from nuclear energy. The results of research and development in areas such as fabrication of fuel elements,

studies of metallurgy, et cetera, combined with the progress made in the construction of pilot- and full-scale plants have all helped in pushing back the barriers of the unknown in the atomic energy field.

But the fact still remains that we will not really know what the costs of generating commercial atomic power will be until commercial power reactors have actually been constructed and operated.

What we really need, it appears to me, is not only construction but also actual operating experience from which to draw experimental data applicable to commercial scale production of electricity from nuclear fission. Without such experience we are, in effect, reaching for something in the dark, and a guess from one expert seems as good as another.

We have been told that the cost of installed capacity for commercial-scale atomic reactor plants would be from $300 per kilowatt up to $800 per kilowatt. This is no guess at all—merely mental gymnastics.

We are told that it will be 10 to 20 years before nuclear power will be competitive with power from other fuels, but on the other hand we are told that economic production with large-scale plants is now feasible in areas of high conventional fuel costs. Still others urge us to more or less forget the problem because we have adequate fossil fuels for many years.

And still others, for instance, tell us that nuclear powerplants will be competitive by 1980, and the Atomic Energy Commission recently took the optimistic view that within 10 to 15 years economic nuclear power generation would be a reality, and by 1975 we could expect an installed capacity of 80 million kilowatts of nuclear power generation.

But AEC officials seem to say all things. I seem to recall Chairman Strauss saying some 3 years ago that electricity generated from atomic power would be too cheap to meter. Did he mean in America? And if so, when?

Senator GORE. Are you quoting?

Mr. ELLIS. That is the substance of his statement.

No; I am not quoting exactly, but that is what he said.

I could go on citing other examples of estimates made by the experts which agree with, are slightly at variance with, or are diametrically opposed to one or several of the estimates related above. This all serves to point up one thing—we just don't know what we can expect. We have no real, direct experience to give us a clue or the answer to the question: Which types of reactors will produce power cheaply enough to be competitive with other sources? We have the faith that some will.

And, as I have said, the main reason we do not know the answer to this important economic question is that we do not have, for all practical purposes, any reactor operating today in this country designed specifically to produce commercial power.

The National Rural Electric Cooperative Association's principal area of emphasis in this area has been public policy—

> adequacy of the law, adequacy of public finance, vision and responsibility manifested by those responsible for administering, and promoting this program * * *

We have insisted from the beginning that if we were to get results in reasonable time public funds would be required—direct or subsidy. Our views seem to have been substantiated—it is over 10 years since the McMahon Act, almost 3 since the 1954 amendments. The private

utilities and Mr. Strauss have repeatedly said: "No! We do not need a dynamic federally financed atomic power program, private industry will do it." They promise, they hedge, they retreat from earlier prognostications and claims under a smokescreen of new claims.

We were told in a nationwide ad appearing in many metropolitan newspapers last summer that the United States had built 55 reactors. This ad was sponsored by 120 private power companies and the ad implied that the sponsors were responsible for the construction of these reactors. Under questioning by a congressional committee, however, we find that the private power companies had nothing to do with the building of these reactors, and further, the witness admitted that the United States could not depend at this time solely on the private power industry to foster the growth and development of the atomic energy program. We were amazed to learn that this advertisement was shown to officers of the AEC prior to its publication, and in spite of the obvious fraud in the ad, the AEC did not offer any criticism.

We have been told by Admiral Strauss, in a speech before the New York Board of Trade on October 10, 1956, that all is well with our civilian atomic energy program, and that we were making amazing progress in this field due to the policies of the Commission. Admiral Strauss said that the people of the United States had built 82 reactors "of all types and all sizes, for all purposes." He failed to reveal the fact that 68 of the 82 reactors were low-pressure types and not suited for commercial power production.

Continuing his remarks, the admiral said that:

> In terms of strictly civilian atomic power, our program includes 30 reactors in operation in the United States, under construction or planned, for experimental or for actual full-scale use. Eighteen of these thirty plants will provide civilian commercial power for homes and industries, beginning with the Shippingport plant next year.

Now, gentlemen, that statement appears, at least to me, to be the boldest kind of facetiousness. To say that there are 30 reactors "in operation * * * under construction or planned * * * for experimental or for actual full-scale use" would be like my saying that I have 30 rabbit hutches in operation, under construction or planned, for experimental or for actual full-scale use. That word "or" is the catch. I do have 30 planned for experimental use. This misuse of the word "or" is one of the crudest tricks known to humanity for giving the wrong impression.

Yes, AEC has one under construction (two if you count the little 5,000-kilowatt-job at Argonne), and maybe some planned, but it certainly does not have one in operation for full use in electrical production.

Senator GORE. You have heard of the rabbit and mule stew, have you not?

Mr. ELLIS. I do not believe so, sir.

Senator GORE. One rabbit and one mule?

Mr. ELLIS. Yes, sir.

Senator GORE. Would you mind giving the date of this speech?

Mr. ELLIS. Yes, sir. I will be glad to give it to you.

Senator GORE. Was it before or after the election?

Mr. ELLIS. October 10, 1956.

Continuing, Mr. Strauss said that 6 of the 30 plants he mentioned would be built by industry without any direct financial subsidy. It would enlighten me to know which plants he referred to. Was he kidding? We think so. If not we wish he would name them. Did he include a proposal by the Pennsylvania Light & Power group, who at the time the Admiral made his talk, said they would not be in a position to decide until 1958 whether they would proceed with their plans? Possibly he included a proposal of three power utilities in Florida who at this time had not even decided what type of reactor they would be interested in building. And so the numbers game goes.

Representative HOLIFIELD. Of course, Mr. Ellis, you know that since then those three utilities in Florida have been denied clearance by the AEC on the grounds that their plans were not well designed? Those three that you refer to are now completely out. You understand that, do you not?

Mr. ELLIS. Yes, sir. And that is why we say that he evidently refers to a lot of this nebulous program, which may never be put into operation at all.

Representative HOLIFIELD. Well, in his statement, at various places throughout his statement, he uses the general statement that certain numbers of reactors are under construction or planned or in process of negotiation. And I agree with you that this is a tricky use of language. It is technically correct to say that 30 are under construction, planned, or in negotiation, possibly.

Senator GORE. Would the gentleman yield on that point?

Representative HOLIFIELD. But to not make a clear statement and divide those three phases in his question into their component numerical equations is a palpable attempt to create an impression on the mind of the hearer that a great accomplishment has been made. And it all rests upon, in my opinion, a tricky use of language.

Representative PRICE. Would the gentleman yield there? But is it not true, though, that several of these had already advanced to the press-release stage?

Representative HOLIFIELD. I think possibly some of them had been announced as the future plans of certain groups, and they had released a press release on them.

I will yield to the gentleman from Tennessee.

A staff member informs me that it was the city of Orlando and the University of Florida that have had theirs withdrawn.

I withdraw my other remark.

Senator GORE. When you say that Mr. Strauss' statement is technically correct, it occurs to me that it might be more accurate to say that the statement forms a sentence which is grammatically possible.

Representative HOLIFIELD. I will accept the Senator's amendment.

Mr. ELLIS. Such utterances of half-truths and inaccuracies should not be tolerated from a public servant in a responsible job. I would like to see the Admiral required to submit a breakdown removing the "or's" from his sentences.

In my opinion, Admiral Strauss has committed another unpardonable error against the American public. He is minimizing the great strides that have been made by the British and Russians in their atomic energy programs. Regardless of what Mr. Strauss says, the fact

remains that on October 17 the British began operating the world's first large scale atomic energy plant at Calder Hall. This plant is to have a net electrical output of more than 60,000 kilowatts. Further, the British report that as a result of recent technological innovations, they plan to have 12 commercial atomic powerplants completed and in operation by 1965 with a capacity of about 6 million kilowatts, 3 times their original expectations.

Representative HOLIFIELD. I would like to comment on your testimony at that point.

In questioning before the committee, Admiral Strauss refused to classify the Calder Hall plant as a civilian- type plant, because it does have the dual purpose of producing plutonium. Now, technically, again, I think the Admiral was right in saying that it was a dual-purpose reactor; that it does produce a plant for 60,000 kilowatts. We understand, incidentally, that it is running higher than that in actual operation. And it does produce plutonium. But he ignores the fact that there is a Commission-advocated study at this time to use plutonium as a fuel. And if these plants which have a dual purpose and which this committee, at least in one stage or another, have advocated further exploration of, if it does produce plutonium, and if the studies on utilizing plutonium as a fuel turn out, you have got a source of reactor fuel coming up in these plants which have the dual purpose.

Also, apparently, as you point out, the recent technological discoveries or innovations which the British have learned as a result of building this full-scale plant and operating it, have seemed to justify to them at least the building of 12 additional commercial atomic powerplants. It is possible that maybe those plants also will produce, in addition to power, some plutonium. But there again you have the possibility of the eventual utilization of plutonium as a fuel. And so you have here, you might say, a breeding process. The plant that produces the 60,000 kilowatts will also produce plutonium, which in turn may be used in a very short number of years as fuel to produce other kilowatts. So this is something I think we ought to consider.

Mr. ELLIS. Thank you, Congressman Holifield. We have been told right along by AEC that the production of plutonium would be helpful economically to us in getting these plants underway, and I am amazed that they now have tried to say that the British plant is not of a civilian type simply because it does produce plutonium.

The British also report that England expects to cut in half the capital costs for its first commercial power stations that were anticipated in the British white paper of February, 1955. With public financing, and allowing a credit for plutonium of 2 to 4 mills per kilowatt-hour, the British estimate that power costs from atomic reactors will amount to from 5 to 7 mills net per kilowatt hour. In the United States, some of the rural electric cooperatives pay private power companies as high as 20 mills per kilowatt hour for wholesale power, 4 to 5 times as much as this British-announced figure.

Russia, too, seems to be progressing at an accelerated pace in the development of their atomic energy industry, although one could not gather this from listening to the speeches of Admiral Strauss.

The Russians have publicly announced what they are doing and what they intend to do in developing this field, and what they propose to accomplish by 1960. They have announced a program for

construction of a whole variety of power reactors with a combined capacity of between 2 million and 2.4 million kilowatts by 1960.

There are articles even today in the press about the Russian gains. Their most recent claims indicate they may even be on the road to a controlled-fusion reactor. If these plans materialize, the conquences will be of the utmost concern to us.

And more recently we have read of the Euratom plan. Under this plan, 6 European nations will combine resources to install 15 million kilowatts of atomic powerplant capacity within the next few years. We can no longer depreciate the progress being made by other nations throughout the world in developing economically competitive electrical energy from nuclear reactors.

Gentlemen, many of the rural electric cooperatives become truly frustrated when they read about the progress being made in the atomic-energy field in other nations. Progressiveness is a relative concept, to be sure, but, when we view this apparent progress abroad, we become weary of the "hocus pocus, twice multiplied" arithmetic of Admiral Strauss.

Last year I accused the AEC, before this committee, of being, in reality, an Atomic "Energyless" Commission. This year, I make the same accusation, but with additional emphasis. I believe it should now be called the Atomic "Energyless" Commission—"twice multiplied."

THE THREAT OF MONOPOLIZATION

Since passage of the 1954 Atomic Energy Act we have been deeply concerned over monopolization of the atomic-energy field by the private utilities and associated groups. We have felt since its passage that the act would promote the very concentration which the Public Utility Holding Company Act of 1935 was designed to prevent. We now feel that our fears have been more than justified.

Up until 1954 access to atomic-energy knowledge was a privilege of only a relatively few large companies such as Du Pont, General Electric, Detroit Edison Co., et cetera. The 13 AEC authorized study groups formed as of this time were the only ones that had access to atomic-power research and development by the AEC.

Atomic-engery exploitation under the various programs of the AEC is being dominated by large aggregations of private utilities and manufacturing companies. Except for the proposals submitted to the AEC by three rural electric cooperatives and a few municipalities, none of which, I believe, have been approved for construction, the program is being dominated by the big utilities and manufacturing companies.

The programs emanating from the AEC—oriented as they are in favor of the private utilities—have brought about a form of legalized collusion. For example, look at the composition of the Power Reactor Development Co. This company brings together 13 giant electric utility companies, 7 large industrial companies, and 1 service company. They own PRDC. Included among the electric utility companies are the Cincinnati Gas & Electric Co., Detroit Edison Co., Potomac Electric Power Co., and the Delaware Power & Light Co. The industrial companies of the PRDC include Allis-Chalmers Manufacturing Co., Burroughs Corp., the Babock & Wilcox Co., and Westinghouse Electric Corp. The one service company is Southern Serv-

ice, Inc., a mutual service company owned and controlled by the illustrious Southern Co., an electric utilities holding company.

The formation of such aggregations as PRDC, the Nuclear Power Group, the Yankee Atomic Electric, Middle South Utilities, and others cannot but lead to collusion and monopolization of the atomic energy field, in the absence of a reorientation of Federal policy.

A recent survey by Electrical World indicates that industry is anxious to go ahead in what this publication calls cooperative development of reactors. These new cooperative groups range in size from 4 to 20 member utilities. The largest of the groups would have about 20 participants, and the smallest between 4 and 6 participants. The remaining groups would range from 10 to 15 members.

The survey also concluded, and this is most significant, that—

> These new groups are being formed principally on an area basis. Along with those groups previously announced, they represent almost all sections of the United States.

This, to us, spells monopoly; it spells exclusion of the farmers' electric cooperatives.

The next step leading toward the monopolization of the atomic energy program by the private utilities came about as a result of the January 17, 1957, decision of the Securities and Exchange Commission in the matter of the Power Reactor Development Co. SEC ruled that since PRDC is a nonprofit corporation which proposes to do nothing more than construct an atomic reactor to produce plutonium and steam, and since the steam will be used by Detroit Edison, a member of PRDC, to generate electricity, and since the generation of electricity has nothing to do with the research and development activities of the PRDC, such activities of PRDC would not classify them as an electric utility company within the meaning of the Public Utility Holding Company Act of 1935. Therefore the act is circumvented. Such logic, or the lack of it, based at best on a strained legal technicality could lead our country down some strange new alleys.

Such decisions, including the OVEC and EE, Inc., SEC decisions, indicate that Federal regulatory agencies are steadily abdicating the responsibilities placed upon them by the Congress to prevent and prohibit the creation of giant, nonintegrated combinations of power company monopolies. This could take us back to the pre-Utility Holding Company Act days with all their vicious abuses.

The next incentive offered to the private utilities to resurrect their pre-1935 monopoly empire came about as the result of the recent announcement of the AEC's third-round proposal. The third-round invitation calls for proposals to build and operate nuclear powerplants which will be completed by June 30, 1962. Conspicuously missing from a list of the types of reactors desired by the AEC under this new proposal is any reference to relatively small nuclear powerplants, of the size we need. In a December 1956 speech by Admiral Strauss, which unofficially heralded the third-round proposals, Strauss suggested giving priority to large plants of the types mentioned in the third-round proposal, "the natural uranium-fuel, heavy-water moderated reactor; and the fluid-fuel reactor system based on aqueous solutions or slurries of uranium or of uranium and thorium-bearing materials," but also to three small-scale projects of "varying new de-

signs." However, the Commission invitation as issued does not report any suggested proposals for any particular types of small reactor demonstration plants.

As under previous invitations of the AEC, certain types of direct AEC assistance are being offered. This assistance includes:

(*a*) Waiver of the 4-percent annual lease charge for fuel materials;

(*b*) Research and development work in AEC laboratories charge;

(*c*) Research and development payments to the project sponsor for technical and economic data derived from the design, construction, and operation of the reactor, with the reservation that such payments cannot be used to defray any part of plant construction costs; and

(*d*) Free loan of heavy water.

Particularly revealing to the rural electric cooperatives and further evidence of this open conspiracy to turn the atomic-energy program over to the private power companies is the provision contained in the new third-round proposal relating to financial assistance for construction costs. The AEC announcement stated that—

Commission assistance would be limited to research and development. Proposers will be required to provide funds for plant construction. [Italics added.]

Under the second invitation, AEC offered to finance all or part of the cost of constructing the nuclear portion of the plant, retaining title to the portion it financed. This provision, and this provision alone, enabled the several municipalities and rural electric cooperatives to submit proposals to participate in the program.

The third-round invitation makes it nearly, if not completely, impossible for the rural electric cooperatives and other consumer-owned utilities to participate in the demonstration program simply because they are nonprofit systems with limited financial resources. The Rural Electrification Administration will not lend funds to the rural electric cooperatives for the nuclear part of a powerplant, but only for the conventional portion.

For consumer-owned utilities, the only possibility for participating under this new demonstration program will be to find a reactor manufacturer who will become a joint sponsor of a project and finance that portion of the plant-construction costs which exceed the amount the consumer-owned utility can provide. This seems unlikely at the moment. Gentlemen, we are deeply concerned over this provision. The AEC, as we interpret it, has launched a program of Federal financial assistance under terms which will permit only the large privately financed and owned utilities, large equipment manufacturers, and aggregations of corporations to participate. The rural electric cooperatives and other consumer-owned utilities with limited financial resources will by definition be excluded from the program.

You gentlemen know that under the AEC power-reactor-demonstration program several electric cooperatives and municipalities have submitted proposals. These proposals include financial assistance from the AEC for construction and research and development. For example, the Rural Power Cooperative of Elk River, Minn., proposal has a total estimated project cost of $9.3 million. (The Rural Power Cooperative is a federated generation and transmission co-op through which several distribution co-ops supply themselves with wholesale power.) The AEC has indicated that it will finance $3.8 million in construction costs of the co-op plant and $3.1 million for research and

development for this project. In the other two co-op proposals, Wolverine, in Michigan, and Chugach, at Anchorage, Alaska, the costs which would be borne by the AEC are about comparable to those of the Elk River project. These three proposals have only been approved as a basis for contract negotiations; no contracts have been signed.

The three cooperatives mentioned had a hard decision to make in even entertaining an idea to enter into contracts to build atomic reactors for a number of reasons. One was Commission insistence that proposals must be closed-end deals with respect to the Commission. This placed these cooperatives with their limited financial resources in the position of either using the best estimates of cost available and assuming the risk of unforeseeable research and development costs that may be required, or of setting their estimates so high as to place their proposals at an economic disadvantage. Yet the cooperatives went ahead with their proposals. Mr. Ed Wolter, manager of the Rural Power Cooperative, was scheduled to testify in these hearings, and he will testify through his assistant, who could furnish you some interesting details on this project.

In the third round proposal, the contention was voiced that if industry does not submit acceptable proposals for the reactor types considered ready for construction, the Commission would ask for public funds to build such projects. This is essentially what Admiral Strauss said before the Joint Committee last year, but industry has not and AEC has not. This also is what the President said in his latest budget message. The President said that the budget did not contain funds for construction of large atomic power reactors by the AEC—

> in the belief that basic responsibility for construction of large-scale commercial power reactors should not have to be assumed by the Federal Government.

But the President also added:

> However, if acceptable proposals for non-Federal construction of promising reactor types do not materialize within a reasonable time, a request will be made to the Congress for funds for direct construction by the Federal Government.

We cannot but conclude that such statements on the part of the President and the Chairman of the AEC are nothing more than an attempt to head off any move to enact legislation which would direct the AEC to build some federally financed atomic reactors.

In this vein, it is interesting to note the General Accounting Office's report of the contract between the Yankee Atomic Energy Co. and the Atomic Energy Commission.

The Wall Street Journal of Thursday, February 21, 1957—and there is a copy of the article attached—said that the GAO criticized the contract because—

(*a*) The Yankee Atomic Electric Co. had not "demonstrated its financial competency";

(*b*) The AEC signed the contract without adequate assurances that the Government will receive benefits;

(*c*) The AEC had no contractual assurance that Yankee would perform work called for in the contract; and

(*d*) The company was getting an unlimited waiver of fuel use charges while other companies seeking contracts with the AEC

are being told that this charge will be waived for only a specified period of time.

Such a conclusion as that of the General Accounting Office, we believe, is well founded. For it is my opinion that a great many American people feel that legislation along the line of the Gore-Holifield bill (S. 151 and H. R. 2154) is long overdue. The people know America does not have a workable civilian atomic energy program now, or even a pretense at one which is in the public interest.

In the face of the administration's zealous desire to turn the atomic energy program over to private industry, note the results of a recent poll conducted by the Atomic Industrial Forum. Based on 167 responses from private electric utilities, they find that "lack of economic incentive" is regarded by industry as the single greatest obstacle to the development of atomic energy for peaceful purposes. Yet, the 1957 Economic Report of the President says:

> On the whole, there appears to be adequate incentive for participation by non-Federal interests in the development and application of nuclear technology.

The Economic Report of the President goes on to say that—

> * * * if there is a lag in the construction of large-scale commercial power reactors by these interests (non-Federal), it may be necessary to request funds at a later date for direct Federal construction.

This, to me, is just tweedledee, tweedledum abdication of responsibility for getting a program underway. Ten years have passed since our Government ostensibly undertook civilian atomic energy development. It has labored mightily and produced a mouse. Gentlemen, this is not like the United States. It is the work of a foreign element in our economy which we thought we outlawed under the Sherman Antitrust Act of 1890 and the Clayton Act of 1914—monopoly.

We feel a reevaluaion of the lack of progress made to date in the development of atomic energy for peaceful uses in the United States is in order. We feel that such a reevaluation would force the administration to conclude that we are lagging far behind the progress that should have been expected; far behind other countries, notably Great Britain and apparently Russia. We believe that it is later than at least the administration thinks.

CONCLUSIONS AND RECOMMENDATIONS

I believe what I have outlined here clearly points to the conclusion that (1) measured against any valid criteria, we are proceeding at best at a snail's pace in the development of atomic energy for peaceful uses; and (2) our country is fostering the monopolization of the entire nuclear energy program, partially as a result of provisions of the 1954 Atomic Energy Act, partially as a result of the abdication of the various regulatory bodies such as the SEC, and partially as a result of the policies of AEC in administering the act.

Progress to date has been most disappointing. It is time for the administration to live up to its much reiterated promise of Federal financing and construction, for after all these years it should be clear to everybody—even the Commissioners of AEC—that private enterprise has not undertaken the task and probably would never do so on any basis consistent with our free competitive enterprise economy.

The rural electric cooperatives are vitally interested in the rapid development of atomic energy as a source of abundant low-cost power. This does not mean that we think the entire job should be done by the Federal Government. But some of it should—enough to get the program rolling and to establish some real yardsticks. The policies of the Federal Government and its agencies will materially affect the pace at which economically feasible atomic power is developed, as well as the degree to which the program is monopolized and exploited. Our rural electric cooperatives believe, as reflected in their resolutions passed at State, regional, and national meetings, that the Federal Government should take the necessary steps to assure yardsticks and competition within the atomic energy field. Only through the institgation of such measures can we achieve low-cost atomic electric power.

As I mentioned at the beginning of my statement, our rural electric cooperatives at their 1956 regional meetings have been quite vocal concerning our country's still-grounded nuclear power program. I could do no better than to conclude my statement with a synopsis of what their recommendations are, as stated in their resolutions:

(1) The rural electric cooperatives want the Congress to enact and approve legislation including sufficient appropriations for the purpose of research and development, construction, operation, and design of nuclear powerplants of different types and sizes to demonstrate their commercial applicability.

(2) The rural electric cooperatives want every necessary precaution taken to assure that the atomic energy program not be given over to the private power companies since this would re-create the complete monopolization of the electric utililty industry.

(3) The rural electric cooperatives want the Congress to provide for the construction of full-scale and pilot atomic reactors, and they want every effort made to speed up the construction of these reactors by the Federal Government so as to provide a yardstick on the cost of atomic power.

(4) The rural electric cooperatives want the AEC to stop muddying the water and provide policies and programs to assure progress in the atomic-energy program.

(5) The rural electric cooperatives want the AEC to approve satisfactory contracts with cooperatives and municipalities so that they can actively participate in the civilian atomic power program.

(6) The rural electric cooperatives want the AEC to enunciate a broad "round" with policies deliberately designed to see that (*a*) all groups can participate equally in the atomic-energy program, and (*b*) no contracts are consummated which promote monopolistically oriented combines such as the Power Reactor Development Co. threatening to set back regulation and control 25 years.

(7) The rural electric cooperatives want the AEC to create a real public advisory commission—with balanced representation from cooperative, public and private electric groups, from the colleges and universities, and from manufacturing companies.

(8) The rural electric cooperatives want the Congress to separate the military and civilian functions of the AEC, and provide for a bipartisan commission to operate the civilian branch.

Gentlemen, I thank you for allowing me to appear before your committee. I would also like to request that a statement by the di-

rector of our research and legislation department, Dr. Clay L. Cochran, be presented to you or inserted into the record.

The CHAIRMAN. Without objection, it will be inserted in the record.

(The statement referred to follows:)

STATEMENT OF CLAY L. COCHRAN, DIRECTOR AND STAFF ECONOMIST, LEGISLATION AND RESEARCH DEPARTMENT, NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION

Mr. Chairman and members of the committee, in an area as new and vital as atomic energy, it is sometimes as important to take a look at the problems confronting us from the standpoint of a political economist or a cultural anthropologist as it is from that of the physicist, a general, a financier, or the manager of an electric or manufacturing corporation. It is with this in mind that I have tried to pull together some of the pertinent data from the past which might throw light upon the problems before us.

Archeologists and cultural anthropologists, as scientists, take a somewhat humble, that is, scientific, view of their findings, because to the scientist all theories, all findings, are tentative and subject to further investigation and more refined conclusions. I would like to stress this point before going into my statement.

From the evidence at hand we have reason to believe that there was once a tribe of people who lived well, according to the standards of the time. They enjoyed a reasonably stable society, a reasonably good diet, and were at peace with themselves and the universe except for the regular war parties which they sent forth against neighboring tribes and foraging parties which hunted the abundant game that provided the basic elements of the tribal diet. This tribe also enjoyed the not too amiable envy of all of the surrounding tribes, and for good reason. In war as in hunting, it was a rare occasion when the warriors or huntsmen of this particular tribe did not enjoy marked success over their competitors.

The explanation for this fortunate state was the high level of development of social organization and the industrial arts enjoyed by the tribe. The focal point in their success was the skill and genius which they applied to the basic material of the then known world, flint. In the Chipper Tribe the finest skills were those which related to chipping the flint from which all of their basic tools and weapons were fashioned.

The art of flint chipping had developed over a period of many centuries, and in the course of time had become the monopoly of a particuluar group, the Royal Society of Flint Chippers. The chairman of the board of flint chippers was also chairman of the tribal council; one of his fellow craftsmen was chairman of the advanced economic commission; and the members of the flint chippers society were the most privileged, most skilled, and the wisest of all of the men in the Chipper Tribe. It had been so for centuries and the tribe had prospered.

At one point in the history of the tribe, however, an incident occurred which, though of brief duration, caused a greater strain and concern to the more enlightened citizens than anything they or the tribal historians could recall. It began with a very ordinary event.

In those warring times, in such sharp contrast to our own peaceful age of world cooperation, the young men of the tribe frequently went forth to war and were sometimes made captive by other tribes. Most of them never returned, but occasionally, soon or late, one of them would return, having escaped or been freed for one reason or another by the enemy. One day one such man returned. He was no longer young, for he had been captured 20 years before, and except for 1 uncle, no one in the tribe even remembered him when he did return. He had been captured by one tribe and sold and resold as a slave far to the east. There he had been held for many years until at last he had escaped and by virtue of a marvelous memory and not a little luck he had been able to find his way back to the Chippers.

He brought with him a strange and wonderful instrument, a bronze ax, a thing which had never even been heard of by his own tribe. But, more important, as a result of his years as a slave, he brought with him—at least, so he said—the technological knowledge and skills for producing bronze and working it into not only axes but other weapons, as well as works of art. He was very proud of the bronze ax, and of his knowledge of the art of smelting and metalworking. And, despite the fact that he was a very humble man, devoted to his tribe, and respect-

ful of his betters, he was reported to have spoken rather freely about the virtues of bronze axes over flint axes. Indeed, he was successful in demonstrating the superiority of the cutting edge of his ax and was apparently somewhat boastful of the other uses to which bronze could be put.

It was not long, of course, before the Royal Society of Flint Chippers knew all about the whole matter, the members being concerned for various reasons. The third vice president of the society was dispatched to look into the matter and set the fellow straight on technological matters, but in vain. The ex-slave, albeit humble and respectful, was adamant in his belief that if the resources of the community were directed along lines he would indicate they could work miracle for the tribe in peace and war.

The events which followed were painful to all concerned. There was a meeting of the tribal council which lasted several days. The most skilled huntsmen demonstrated the relative merits of the bronze versus flint axes, and, although the spectators were divided in their loyalties, the demonstrations created evident consternation in the ranks of the Royal Society of Flint Chippers and most of the other really respectable people in the community.

A particular stone tablet of disputed authenticity, the translation of which also remains somewhat obscure, is purported to indicate a special (or executive session) meeting of the Royal Society of Flint Chippers following the demonstrations. The consensus of this meeting appears to have been that, although bronze axes were clearly to be branded as inferior to flint axes and their integration into the tribal economy was out of the question, it behooved the Royal Society of Flint Chippers as a matter of tribal responsibility to take at least a passive interest in this cultural curiosity called bronze. It was thus proposed that the Royal Society offer to relieve the tribal council of any further responsibility and travail regarding this unfortunate development. Although the excellence of the highly refined flint implements furnished the tribe by the Royal Society of Flint Chippers made it clear, it was argued that the use of the new substance was unnecessary, still the flint chippers were recognized as a forward looking group and it might even prove feasible at some remote future date to equip flint axes with bronze handles.

The proposal to be made to the tribal council was an eminently equitable one. To assure a continuity of tradition and to avoid further disruption of social stability, "bronze matters" were to be completely turned over to the Royal Society of Flint Chippers. There must be no thought of allowing this controversial matter to fall into the hands of unregistered flint chippers or those few corn cultivators who attempted to make their own flint implements. In return for thus relieving the tribal council of such matters, it was only fair that the grain and venison rations of registered flint chippers be substantially increased. If apprentice flint chippers were to waste their time on this dubious project, considerable compensation from the tribe had to be expected.

Under the terms of such a reasonable proposal, the Chipper Tribe would escape the dire costs implicit in the ex-slave's fantastic proposals, while being assured that the matter rested in competent and reliable hands. After all, argued the most venerated members of the Royal Society, the supplementing of a tried and true material like flint with something new and untested like bronze was a matter that would require long study and careful procedures.

Whether or not the above source is to be credited, other evidence is in substantial agreement on the conclusion of the episode. The Tribal Council's Special Commission, under the chairmanship of a retired warrior who was also an honorary member of the Royal Society of Flint Chippers, was appointed to assess the ex-slave's extravagant claims. It reported that the tribe need not further trouble itself in the matter. The ex-slave himself was ordered into exile as a menace to the unity and decency of the tribe and as a danger to the stable continuity of tribal traditions. The tribal elders, under the influence of the Royal Society of Flint Chippers, decree that in the interest of tribal order a stern taboo be placed on any further discussion of the evil doctrines spread by the now-exiled ex-slave.[1] Thereafter the tribe continued to live in unity and prosperity and as much peace as could be expected considering the times. At least this is the gist of the tribal records which have been laboriously translated by archeologists.

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[1] The translations of the tribal history are somewhat less than perfect, and there is some dispute as to whether the discussion of "bronze matters" could better be said to have been "taboo" or "classified." For immediate purposes the distinction is hardly relevant.

Subsequent research by archeologists, aided in their interpretation by some of the world's leading anthropologists, however, leave some doubt as to the ultimate authenticity of the reports of the tribal historians. There is some evidence to support the belief that the tribe was destroyed by either a virulent disease such as smallpox, or by soil erosion which reduced the game supply. But these conclusions are conjectural and await further research. Other archeologists insist that the flint chippers were overrun and wiped out or enslaved by other tribes armed with bronze-tipped arrows, bronze axes, and other bronze weapons. Pending further research, the one thing of which we are positive is that above the many layers upon layer of bronze artefacts, of a design so different that there is no doubt that they were the product of workmen of a wholly different culture.

The CHAIRMAN. Thank you very much, Mr. Ellis, for giving us your time. I am sure you have given a lot of thought and study to this problem, as we all have.

Any questions?

Representative HOLIFIELD. Mr. Chairman, I too, want to compliment Mr. Ellis on the general purport of his statement.

I do want to ask you a question. On page 20, in recommendation 6, you say that you object to contracts consummated which "promote monopolistically oriented combines such as the Power Reactor Development Co. threatening to set back regulation and control 25 years." Just what did you mean by that?

Mr. ELLIS. This, Congressman Holifield: The regulatory acts passed in the early thirties, both the Federal Power Act amendments and the Securities and Exchange Act, provided for certain controls designed, among other things, to break down the great farflung power monopolies in America, and to require that those remaining be only integrated systems or those subject to integration.

Representative HOLIFIELD. I understand now what you mean. You are referring to the Utility Holding Company Act and the Sherman Antitrust Act and that type of regulation. I did not know but what maybe you were looking forward to an absence of regulation and control over this particular project.

Mr. ELLIS. Congressman Holifield, I think that the laws have, in all effects, and to all intents and purposes, been negated with regard to regulation, with regard to preventing combines, with regard to preventing holding companies or holding company controls of unintegrated systems throughout this country.

The CHAIRMAN. You have taken issue with the SEC ruling. Under the law they ruled, under the old statute, that these people had the right to do this. Is that what you question?

Mr. ELLIS. Yes.

The CHAIRMAN. You know there was no change made in the act by Congress.

Mr. ELLIS. Yes. I understand, Congressman Durham. What I am trying to say is that the total effect of all of these things is to detroy regulation in this area as among the power companies of the country. They are combining. They are going together on a vast scale. And instead of it being vertical holding companies upward that control them, they are joining together as holding companies to form these nuclear power companies, and they are holding the common stock in these companies, and thereby they are coming together again, as great farflung monopolies in America.

Representative HOLIFIELD. I want to question you a little bit further on that. You feel that because the utilities went together in this one

corporation, the purpose of which is an experimental development project, which had an agreement, as I understand it, to sell at conventional prices to a utility company, either the thermal units or the kilowatts—you feel that that is violating the Utility Holding Company Act, do you?

Mr. ELLIS. Congressman, I do not want to say that I think it violates the act technically. I do want to say that I think—that I am confident—that it violates the letter and spirit of the act.

Representative HOLIFIELD. Well, in view of the fact that this is a nonprofit company and that it is organized for the purpose of research and development and the discoveries which will be made in that company ostensibly will be available, of course, to all the members of that group, how do you differentiate legally between their right to do that and their right to engage in research and development as individual companies? Is there a principle, do you think, involved there, that the mere fact that they get together in a nonprofit research and development program—do you think that is violating the principle set forth in the act, which provides against direct financial control in profitmaking enterprises?

Mr. ELLIS. In this way: These people are going into the production business.

Representative HOLIFIELD. Wait a minute now. Who is going into the production business?

Mr. ELLIS. The Power Reactor Development Co.

Representative HOLIFIELD. They are going into the production of steam?

Mr. ELLIS. Yes.

Representative HOLIFIELD. All right.

Mr. ELLIS. Which is a factor, and a mighty important one, in the production of electricity.

Representative HOLIFIELD. But they are not releasing that steam to a combination of plants. They are releasing it to one plant on a conventional sale basis, on a conventional price-tag basis. So their cooperation, as I see it, only goes so far as their mingling of funds in research and development.

The sale of steam which may result from this research and development enterprise is a byproduct of their main purpose, which is research and development, but it is pretty well, I think, admitted in advance that this will not be a profitable operation. And I just cannot quite follow you into your position.

Mr. ELLIS. On two points, if I may go just a little further: One, on the point of a group of power companies going together to obtain a corner on the technology, to gain knowledge and experience which will not be available to others, not as single companies, but as a far-flung group which monopolizes an industry within a given area.

The CHAIRMAN. They have to make that information available under their agreement.

Mr. ELLIS. That takes me to the second point. The Federal Power Commission and the State regulatory bodies have determined over and over and over again that when you get into the holding-company business, you are never able to adequately trace costs. No one group can do it, not even the Federal Power Commission.

One of the purposes of the Holding Company Act was to bring the utilities down into integrated systems for the purpose of being

able to follow cost structures. There were as many as 10 or 12 tiers of holding companies in existence when the act was passed and the act broke it down to 3 tiers, as a limit.

Now, one of the purposes, I repeat, was so that they could follow costs. Here we are scattering costs through many companies.

Representative HOLIFIELD. Now, wait a minute. I am going to differ with you there. The costs will be concentrated in the PRDC, and the respective contributions from the different companies will be known and therefore the cost of the PRDC operations will be reflected in the PRDC books as I understand it, and available to the AEC, and therefore available to the Congress and to the public. So any operation that they engage in can be accounted without going into the intricacies of all these different companies, if I am correct in my understanding of the operation.

Mr. ELLIS. Well, Congressman, if you look at it strictly on the books, that may be true. But does anybody suspect that Detroit Edison Co., as a separate company, apart from PRDC, is not going to gain a great deal through its specialists, who will work closely with PRDC but are on Detroit Edison payroll, in knowledge and operating experience?

Representative HOLIFIELD. I think that they will gain a great deal, and I think that every participating company will also gain by the same factor. But personally, I cannot object to that. If they have put their money into the project, it seems to me they are entitled to it, just the same as if one of your cooperatives go in and put in a contribution into some kind of a joint enterprise with AEC. They, too, would be entitled to such techniques and knowledge as they would gain out of this association.

Mr. ELLIS. I know you know this, but may I run over this list of companies involved in PRDC?

Representative HOLIFIELD. Well, I would suggest it is getting late. I would suggest we put them in the record at this point. I am well aware of them. (See pt. 1, p. 266.)

Mr. ELLIS. All right, but let me make this point.

Here are consumers scattered over a large segment of the United States financing this total bill.

Representative HOLIFIELD. Now, that is a different problem.

Mr. ELLIS. Oh, yes, it is. But for what purpose? For the purpose of giving monopolies a greater monopoly.

Representative HOLIFIELD. Well, that gets into the philosophy. Of course, I believe that the Federal Government should finance the research and development, as you know, rather than the consumers of any one or any group of private utilities. That is, I believe that it would be a quicker and more efficient way, and it would be a safer way, in that the technology which actually stems from the expenditure of $14 million worth of tax money, would then be made available on a free basis to all utility consumers, whether they be public or private.

I would agree that would be desirable. But I cannot quite follow you in your argument against this PRDC operation.

The CHAIRMAN. There is nothing that prevents rural electrification cooperatives from coming in and forming the same combine and doing the same thing if they so desired. There is nothing in the law that

prevents it. You can form the same group. As I see the act, Congress was very careful, to see that there was no discrimination made on any producers of electric power. Now, if anything is in the act that is undesirable and forms a monopoly, certainly I would be one of the first to try to clarify that.

Mr. ELLIS. Our principal complaint on that score, Congressman, is the administration by AEC. Because of the way they set up these structures in the third round they have excluded us.

The CHAIRMAN. Then you do not think it is a fault of the law?

Mr. ELLIS. Well, in part.

The CHAIRMAN. It is the interpretation of the law that you object to?

Mr. ELLIS. In part, Congressman, because we think the Government ought to provide a lead-out to the construction and operation of enough plants so that we actually know the cost. And I would come back to this PRDC case in this way: that despite the fact that these books will be available to AEC or to anybody, for that matter—these books of PRDC—you cannot take the books and tell what the costs are of a power company operation.

The CHAIRMAN. I would probably agree with you on that, because with research and development, it is always difficult to determine the costs anywhere, even on the best of the projects. But I believe in developing the art. This is one way, in my opinion, that we can spread it out to all groups of people. Because there is certainly nothing secret about it. This is available to you or anybody else under this procedure, as I understand.

Representative HOLIFIELD. I am going to study this third round in the light of your testimony on it. But I do call to your attention one thing, that the present act, the 1954 act, does prohibit the Atomic Energy Commission from actually constructing or diverting funds of allocating funds for the construction of reactors which are owned by persons other than the Government. That is a condition of the act at the present time. So that the third round does not change that. The Gore-Holifield bill merely directs what we think is permissive under the present act. We think that the present 1954 act is permissive in allowing the AEC, if it so desired, to build for the Government large scale plants. The Gore-Holifield bill was to indicate a direction to the Commission to do that which we think is already permissive. But in both cases, whether it be permissive or mandatory, as under the Gore-Holifield bill, it would still be necessary for the Government to retain ownership of the reactor, as it has in the Shippingport case.

Now, the only way that I know of that the Government could build a reactor for the cooperatives under the present act would be to follow the Shippingport formula and build a reactor which would be owned by the Government.

The heat transfer and the turbines and so forth would be probably furnished by the cooperative, and then buy the steam from the Government at conventional prices. This is the only way I know of that the Government could step in, outside of the research and development part, and actually participate in the construction of a reactor.

And at this point I am going to conclude by just saying that I think that all of these cooperatives ought to be very careful and not get their fingers burned by hypothecating their own funds or their hopes

for funds into this research and development state. It is too big for them. I think it is too big for private industry. That is why the Gore-Holifield bill was put up. Because we do not believe that private industry will do the job. And, certainly, if private industry, with its access to profitmaking and its access to its reserves, which it is allowed by law to accumulate—if they have not been able to see how they could do the job, I do not see how your cooperatives could come in and enter into this. And I prophesy that if these different cooperatives that are now fluttering around the flame get into this, they are going to get their fingers burned. They are going to jeopardize their financial position, and they will end up having to raise their rates to the point where they will go on the rocks, and some private company will absorb them. That is my prophecy on that point.

The CHAIRMAN. Thank you very much, Mr. Ellis.

The hearing is adjourned until 2 o'clock.

(Whereupon, at 12:30 p. m., the hearing was adjourned until 2 p. m. the same day.)

AFTERNOON SESSION

(The hearing was resumed at 2 p. m.)

The CHAIRMAN. The committee will come to order.

I believe our first witness this afternoon is Mr. Benjamin C. Sigal, who will testify in place of Mr. James B. Carey, president of the International Union of Electrical, Radio, and Machine Workers AFL–CIO. You may proceed, Mr. Sigal.

STATEMENT OF BENJAMIN C. SIGAL, GENERAL COUNSEL, INTERNATIONAL UNION OF ELECTRICAL, RADIO, AND MACHINE WORKERS, AFL–CIO

Mr. SIGAL. I am Benjamin C. Sigal, general counsel of the union of which Mr. Carey is president, and I will give testimony in his place.

The CHAIRMAN. Thank you very much, Mr. Sigal. Do you have a prepared statement?

Mr. SIGAL. Yes, and it has been given to the committee.

The CHAIRMAN. You may proceed.

Mr. SIGAL. As I stated, Mr. Carey is unable to be present here this afternoon, and I will give his statement in his place.

I am general counsel of the International Union of Electrical, Radio, and Machine Workers, AFL–CIO.

My remarks will be directed not to the formulation of new policy for the Atomic Energy Commission, but to an examination of the way that the Commission has been executing certain phases of its current policies.

It is our conviction that, if the administrative practices I shall discuss are not corrected, the entire program of Congress in this field will be profoundly affected adversely. These practices were revealed in a proceeding instituted by several international unions in a license application involving the Power Reactor Development Co.

I want to say at the outset that I do not intend to discuss any issues which are now before the Commission for decision in that proceeding. However, in order to state the problem adequately, it is necessary to outline some of the issues briefly for background purposes.

Now, on June 6, 1956, the Commission's Advisory Committee on Reactor Safeguards, after considering the plans which the PRDC had submitted for the building of a reactor, arived at the following conclusions:

1. Even though there are no facts or calculations available to the Committee that clearly indicate that the proposed reactor is not safe for this site, the Committee believes there is insufficient information available at this time to give assurance that the PRDC reactor can be operated at this site without public hazard.

2. It appears doubtful that sufficient experimental information will be available in time to give assurance of safe operation of this reactor unless the fast reactor program of the AEC is amplified and accelerated as detailed below.

3. It is impossible to say whether or not an accelerated program would give sufficient information to permit safe operation of this reactor at the Lagoona Beach site on the time schedule presently proposed.

That was the summary of the findings of this Safeguards Committee.

Nevertheless, the Commission did, on August 4, 1956, issue a conditional construction permit to PRDC for construction of a fast breeder reactor at the proposed site near Monroe, Mich.

The permit did not make any findings that the proposed reactor could operate safely, or that PRDC had established its financial qualifications to build and operate the proposed reactor.

Now, the permit states in part—I just want to quote two short paragraphs:

D. (1) There are identified areas of uncertainty regarding the hazards potential of fast neutron breeder reactors that must be investigated and resolved. From the current state of the technology applicable to such reactors, it can reasonably be inferred that there may be other areas of uncertainty not yet identified and requiring investigation and resolution * * *

E. Although PRDC has submitted evidence of a commitment from certain banks for a loan of $15 million and has described its plan for obtaining additional financing from its member companies, the evidence submitted to date does not justify a finding with respect to the financial qualifications of PRDC and accordingly the continued effectiveness of this permit will be conditioned upon a further showing in this regard as stated below.

I cannot at this time go into the questions involving safety. On the question of qualification, I think it is fair to state that, at the time PRDC received its permit, its resources were little larger than those of the Yankee Atomic Electric Co. at the time AEC executed its contract with that company.

As you know, the General Accounting Office, a few days ago, said on that transaction, in part, that—

We believe that, because of the lack of firm agreements between Yankee and its sponsors, Yankee has not demonstrated its financial competency and that AEC executed the contract without adequate assurances that the Government will receive benefits commensurate with its investment.

Now, consider the situation of PRDC on August 4, 1956, the date AEC issued its permit.

Its proposed reactor was estimated to cost in excess of $40 million. On August 4, 1956, PRDC had assets of approximately $1½ million to meet a $40 million commitment. It had no firm commitments for contributions from any of its members. It had no firm commitment from banks for any loans.

After fully considering the issues involved, 3 international unions with substantial membership within a radius of 30 miles of the site

of the proposed reactor intervened in this proceeding, on the ground that the permit had been illegally granted, requested a hearing on their objections, and asked that the permit be suspended pending a determination of the issues. The unions which intervened are the United Automobile, Aircraft, and Agricultural Implement Workers of America, otherwise known as UAW, the IUE, and the United Paperworkers of America.

The essence of the union's objections is that AEC, not PRDC, had acted illegally. The reasons for that contention may be summarized as follows: I will do it very briefly.

The Atomic Energy Act of 1954 prohibits construction of a utilization facility except pursuant to a construction permit. And section 50.35 of the Commission's regulations requires a finding by the AEC that there is—

reasonable assurances that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public.

And it requires that finding as a prerequisite to issuance of a construction permit on a provisional basis.

At the time AEC issued its conditional construction permit to PRDC on August 4, PRDC had not submitted sufficient information to AEC to provide such reasonable assurance.

Further, the act and sections 50.40 (b) and 50.45 of title 10, of the Code of Federal Regulations require that the AEC find as a condition of receiving a construction permit on any basis that the applicant is "* * * financially qualified to engage in the proposed activities" in accordance with AEC regulations. Section 50.60, title 10, of the same regulations, requires that before AEC includes in a construction permit any allocation of special nuclear material, it must find that—

The applicant appears to be financially qualified to assume responsibility for the payment of Commission charges for the material and to undertake and carry out the proposed use of special nuclear material for a reasonable period of time.

At the time that AEC issued the conditional construction permit to PRDC on August 4, PRDC had not established its financial qualifications. And the AEC itself stated that—

* * * the evidence submitted to date does not justify a finding with respect to the financial qualifications of PRDC.

The AEC granted the interveners, that is, the unions, a hearing, but refused to permit them to go into the question of whether AEC had violated the law in granting any kind of a permit to PRDC on August 4, 1956, and refused to suspend the construction permit. It refused to permit an objective examination of its own conduct and procedures. Instead, it converted the interveners' challenge into a proceeding to determine whether or not the applicant "is able to satisfy those requirements of law and the Commission's regulations which are in controversy."

Now, the controversy initiated by the interveners was whether the AEC had satisfied the requirements of the law and the Commission's regulations; not whether PRDC had satisfied those requirements. If the interveners had not demanded a hearing, there would have been no hearing. There would have been no investigation. And there would

have been no need on the part of PRDC to satisfy the requirements of the law, at least at the present time.

The AEC stated, in answer to various arguments we have made, among others, that—

*** * * The purpose of the hearing is to determine what order should be issued in the public interest at the conclusion of the hearing and not to determine what the situation was on August 4, 1956.**

Representative HOLIFIELD. Mr. Chairman, I would like to ask a question here.

What position did you find yourself in as an intervener? Did you find yourself in the position of having to submit to the terms of intervention as imposed by the AEC, or did you in your own right have rights to intervene? Was it permissive, in other words, on the part of the AEC that this question be considered, and did you have to consider it on their terms?

Mr. SIGAL. We had to consider it on their terms and only on their terms.

Let me give something of the background. We followed the regulations of the Commission in filing our request for a hearing. And we set forth in that motion for intervention all the reasons why we felt we had an interest, and set forth all these violations, some of which we have mentioned here.

The AEC considered that motion, along with any comments the other parties had to offer, and then issued an order, in which it set forth certain specifications of issues, four issues, in effect, in which it said: "These will be the issues on which the hearing will be conducted."

Representative HOLIFIELD. And did they include all of the issues that you proposed?

Mr. SIGAL. They did not include the issues that we had proposed. They ignored, they completely ignored, all of the issues with respect to the question of whether the AEC itself had violated the law. And the only issues they stated as being proper for consideration during this hearing were whether or not PRDC could give reasonable assurances of safety and whether it could establish that it had financial qualifications, and it also set forth, although nobody had raised this question, the issue: "Should the AEC give an exemption from its regulations for PRDC?" Nobody raised that question, but the AEC, on its own, suggested that if the PRDC could not fulfill the requirements of the regulations, maybe AEC should grant an exception from those regulations.

The CHAIRMAN. Did that bar you from the courts?

Mr. SIGAL. Not yet. The point is that we cannot go to court until we have finished the administrative proceedings. Those are the usual rules.

Representative HOLIFIELD. In other words, the AEC insisted on using the Administrative Procedure Act first?

Mr. SIGAL. Yes. Well, that is the general rule, and we did not challenge that. We have to exhaust our administrative recourse first before going to court.

Representative HOLIFIELD. And did they appoint the examiner? Who appointed the examiner?

Mr. SIGAL. They did.

Representative HOLIFIELD. A special examiner was appointed?

Mr. SIGAL. Yes. The AEC itself has no examiners, I understand, and they appointed Mr. Kyle, who is an examiner for the Federal Communications Commission.

Representative HOLIFIELD. I see. In other words, they borrowed him, you say.

Mr. SIGAL. They borrowed him for this purpose; yes.

Representative HOLIFIELD. Was he paid by them?

Mr. SIGAL. I am sorry. I cannot say. I would assume that they would reimburse the Federal Communications Commission for his services, but I just do not know how he is paid.

Representative COLE. Did you have any complaint against their selecting somebody from AEC to serve as examiner?

Mr. SIGAL. No; we made no complaint. We know they have no examiners of their own, at least at this time, and we made no complaint on that score.

Representative HOLIFIELD. Does the Administrative Procedure Act provide that the agency complained against can, in effect, set the area upon which it shall be interrogated, or challenged?

Mr. SIGAL. Well, now, that is, of course, a question on which we have very strong differences of opinion with the Commission. Our position is that the Commission does not have the right, once it grants a hearing.

The Commission can decide for itself whether the parties, the interveners, show sufficient interest to be entitled to a hearing. Nobody challenges the fact that we had an interest. We set forth an adequate statement on that.

Our position is that once a hearing is granted, AEC does not have the right to refuse to hear a challenge of this nature, namely, one that goes to the legality of the Commission's own conduct.

Certainly we do not deny the Commission's overall authority to have some control over the hearings. But that it should completely refuse to hear the challenge to its own conduct, we think, is not within the intention of law, not within the intention of Congess in providing for hearings.

Let me, if I may, just call attention to what the Atomic Energy Act itself provides. The language is very general.

Section 189 states that in any proceeding under this chapter for the granting, et cetera, of any license, the Commission shall grant a hearing upon the request of any person whose interest may be affected by the proceeding and shall admit any such person as a party to such proceeding.

That is what the statutory provision is.

The CHAIRMAN. Evidently you have attended these hearings before. What is the difference between the procedure under the AEC and, say, the Labor Department? Do they not follow the same procedure essentially?

Mr. SIGAL. You understand, Mr. Chairman, that each department has different kinds of laws to administer. And our position is that in any of these agencies, where the agency takes an action which is considered to be illegal, or which a protesting party challenges as being illegal, the agency does not have the right, once it grants a hearing, to refuse to consider the question of the legality of its own conduct.

Now, that is what we say here.

We challenged them on that. After they made this order, the matter came up on the question of whether or not we would be limited in our presentation of evidence to the specification of issues. And the Commission flatly said exactly that: that, so far as the presentation of evidence was concerned, we could not go beyond the specification of issues.

So there cannot be any question that we are excluded, so far as the Commission is concerned, from raising questions as to the legality of their own conduct.

We are not raising trivial questions. We are raising questions that go to the heart of the law. There is the question of whether or not AEC issued a permit when they had no right to issue it, when, at the time that they issued it their own committee had said that no safe reactor could be built of the kind that they were proposing to build; and where the record itself showed they had a million and a half dollars to build a $40 million reactor. They had no firm commitments for any other money.

It is not enough to say that they subsequently got some commitments. The fact is that their own regulations say that at the time the construction permit is issued applicants have such qualifications. There is no question that PRDC did not have the qualifications.

What was the rush? Why did AEC have to issue a permit August 4 rather than on October 4 or December 4? There was no emergency.

Those are fundamental questions.

The CHAIRMAN. On how many points did you challenge them?

Mr. SIGAL. How many points?

The CHAIRMAN. Yes.

Mr. SIGAL. I am sorry. I do not have the motion. But basically, these were the 2 points, the 2 important points: the fact that the AEC issued its permit without making two essential findings, one, that there was reasonable assurance that this could be operated at this site safely; and, secondly, that they had the financial qualifications to build the reactor.

The financial qualifications are important to us, as representing people in the community, because without the necessary qualifications PRDC cannot build a safe reactor. Our essential interest is safety.

The CHAIRMAN. Well, you did not include the point of whether or not they were violating the law?

Mr. SIGAL. Oh, yes. I say these are the two main points. We raised some others. But these are the two principal issues.

And we were denied a hearing on the question as to whether or not the AEC had a right to issue that permit at the time, without making the necessary findings.

Now, what we are urging the committee to do is to investigate the conduct of the AEC in this regard, because we can no longer do so. We no longer have a forum before the Commission to do so.

Representative COLE. You have a forum in the courts; do you not?

Mr. SIGAL. Two or 3 years from now we will get a decision from the court after this reactor is built.

Representative COLE. You have authority to stop it; do you not?

Mr. SIGAL. I have to disagree with you on that, Mr. Cole. We have not exhausted our administrative recourse yet and, until we do that, we do not think that any court will listen to us.

Representative COLE. You have exhausted it so far as the question of legality is concerned.

Mr. SIGAL. We have not exhausted the proceeding.

Well, I do not know that this is the place to argue the point.

Representative COLE. Then why do we engage in it at all?

Mr. SIGAL. The point I think there is no point in arguing, Mr. Cole, is whether we can go to court now or whether we have to wait 6 months. In our view, a recourse to the court now would be futile, because we have not completed that proceeding.

This is why we think this is so dangerous. It is not merely a private question of whether we are denied a hearing at this time. We have no private interest in the matter. Our interest is a public interest in this matter. We have no monetary stake in this situation.

But we submit that if the Commission may blithely ignore the established requirements for the issuance of construction permits, incalculable damage may be done to the entire development program.

If it appears that there is no way to guard against arbitrary, capricious, and discriminatory treatment of applicants, worthy projects may die a-borning. If some applicants must demonstrate solid financial qualifications in order to get a permit, whereas others can get one with a showing of scarcely more than a hope and a prayer, the conclusion will be inescapable that it is not the public interest which determines the choice of successful applicants.

If some applicants can get permits without providing assurances of safety, why should not all applicants be placed in that position? The present policy, with all its implications, cannot but seriously jeopardize development of the power-reactor program in the public interest.

These are only a few of the portentous issues which arise out of the refusal of AEC to give the interveners a hearing on the basic issues they have raised. We feel that they are of such magnitude that this committee should look into them without delay.

There is another matter of great importance which emerged in this case. The Commission has taken action which has had the effect, by accident or design, of drawing a curtain between nuclear experts and critics of the Commission. To put it bluntly, prospective witnesses have been threatened by the Commission with reprisals if they testify contrary to the Commission's interests.

Representative COLE. Can you support that?

Mr. SIGAL. I propose to do that immediately.

Representative COLE. Good.

Mr. SIGAL. Now, the situation arose as follows:

In a letter, dated November 5, 1956, Mr. H. L. Price, the Commission's Director of the Division of Civilian Application, informed me as follows in part:

It is recognized that parties——

Representative COLE. Let us put the whole letter in. Then there will be no question.

Mr. SIGAL. The committee has the whole letter. I sent the correspondence to the committee.

Representative COLE. But other people may not have that whole record. I suggest that the whole letter be put in at this time. Then there will not be any charge of picking something out of context, which I do not accuse you of doing, but somebody later might so charge you.

The CHAIRMAN. Without objection, the letter is included in the record.

(The letter referred to follows:)

ATOMIC ENERGY COMMISSION,
Washington, D. C., November 5, 1956.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL–CIO,
% Benjamin C. Sigal, Esq., 1126 16th Street NW., Washington, D. C.

GENTLEMEN: The purpose of this letter is to inform you regarding release by the AEC of information pertinent to the issues in formal hearings under the licensing program. All such information that is unclassified may be made available to the lawyers and other representatives of the parties to such a proceeding. Pertinent classified information may be made available under policies pertaining to the disclosure of classified information.

It is recognized that parties to normal hearings frequently will want to call employees and consultants of the Commission and employees of Commission contractors as witnesses in the hearings. There is no objection to such employees and consultants appearing as witnesses at a hearing. However, responsible Commission officials will have to make sure that the time of AEC employees and consultants is not taken up to an extent that interferes unduly with the Commission's program. Furthermore, it should be recognized that Commission contractors have the right to supervise their employees within established personnel policies.

The policy referred to above does not authorize the release of any privileged information or documents whether classified or not.

Sincerely yours,

H. L. PRICE,
Director, Division of Civilian Application.

Mr. SIGAL. This happens to be the essential paragraph:

It is recognized that parties to formal hearings frequently will want to call employees and consultants of the Commission and employees of Commission contractors as witnesses in the hearings. There is no objection to such employees and consultants appearing as witnesses at a hearing.

However, by letter to me dated December 14, 1956, Mr. Price substantially modified that position.

In that letter, he declared; and I am quoting the entire essential part of the letter:

To avoid any possibilities of Commission employees and consultants becoming involved in conflicts of interest in violation of law, we have modified the position stated in the second paragraph of the November 5 letter. Employees may appear in response to subpenas, subject to any direction of the Commission in regard to such subpenas. Commission employees have been directed not to serve voluntarily as witnesses for any party, other than AEC, to a formal hearing of the Commission.

Commission consultants have been advised that the Commission interposes no objection to their voluntary appearance on behalf of any party to a formal hearing of the Commission. This is in recognition of the fact that Commission consultants only provide their services to the Commission on a part-time basis and the Commission does not feel it would be justified in imposing controls over activities when they are not in the employ of the Commission. Of course, to the extent that such consultants voluntarily appear as witnesses to any party, they do so in their private capacity and not as representatives of the Commission. However, the Commission has advised its consultants that voluntary appearances might involve a conflict of interest with their activities as consultants to the Commission, and that they may wish to consult private counsel in this respect.

We were informed that all Commission employees and consultants were advised of this letter. Its chilling effect was immediately obvious, when we sought to interview such persons, although no one expressly attributed to this letter his reluctance to talk to us. It is understandable that employees and consultants whose livelihood is more or less directly affected by AEC would need no strong urging to withhold cooperation if advised that the Commission frowned on such activity.

On December 31, I wrote to the Chairman, Lewis L. Strauss, as follows, in part:

> So far as AEC employees are concerned, the Commission may be within its prerogatives as an employer to direct them not to testify voluntarily. However, once a lawful subpena has been served upon an AEC employee, the Commission does not have authority to furnish any direction to him regarding his testimony.
>
> Mr. Price's advice to consultants is even more unwarranted. We understand that such advice has been, or will be, tendered to all AEC consultants whether or not they have asked for the Commission's view or advice, and whether or not their consulting activities for AEC have had any relationship to the issues in this proceeding. The Commission has gone far out of its way to suggest the possibility of prosecution for violation of the conflict of interest laws. Such suggestion is a gross distortion of the laws. This proceeding does not involve, as the conflict of interest laws require, "a claim against the United States." It does not involve a demand against the Government for money or property. Without this, such laws do not apply.

Then I continue:

> Even if you disagree with the foregoing interpretation of applicable law, you are surely aware that the Commission has repeatedly asserted that the AEC will not treat the objections filed by the intervenors in this matter as an action against AEC. The Commission has reiterated that this is an initial licensing proceeding, that the right of Power Reactor Development Co. to a construction permit will be determined as of the time this proceeding is ended, and that, in effect, the conflict is between that company and the intervenors. Consequently, to repeat, this is not an action against AEC. The Commission cannot consistently assert, therefore, that a consultant, or an AEC employee, who testifies for one of the parties may be testifying against AEC and thus find himself in an illegal conflict of interest.
>
> The Commission's action, as revealed by Mr. Price's letter, will, whether intended or not, have an intimidating effect on AEC employees and consultants, so as to deter them from assisting intervenors in the pending action. There is widespread concern in the atomic energy field that the Commission will retaliate against any persons who oppose its policies, and that such retaliation will be highly prejudical to their future activities in nuclear industry. The advice which the Commision has now given to its consultants will, regardless of the Commission's intentions, be deemed by them as an ill-concealed threat of reprisals.

And this correspondence was at that time sent to this committee.

Representative COLE. You take it, then, I judge, that a communication from the Commission to the Commission's consultants, pointing out the possibility of a conflict of interest, in which they might be personally involved, is of such a nature that the Commission suggests that they consult an attorney; that that constitutes a threat and intimidation?

Mr. SIGAL. Under the circumstances, yes. They have never done it before, to our knowledge. And we think that there is no warrant. Why should they offer this advice unsolicited?

Representative COLE. What was the advice?

Mr. SIGAL. To consult a lawyer, because they may be guilty of a criminal act if they testify.

But may I proceed, Mr. Cole? This is not the end of the story.

We think it is clear, as things stood as of that time, that there was nothing in that letter indicating any justification for the Commission's position.

There are two types, two groups, of conflict of interest laws. There is section 283 and 284 of the code, which makes it a crime for present employees or officers of the Government, and under certain circumstances former employees or officers, to prosecute or assist in the prosecution of any claim against the United States.

Then there is another law, incorporated as section 281——

Representative HOLIFIELD. Now, before you leave this: You say "to assist in the prosecution of claim against the United States."

Mr. SIGAL. That is right.

Representative HOLIFIELD. You contend that you were making no claim against the United States, and as I take it that referred to a claim for moneys or some kind of thing of value.

Mr. SIGAL. That is right. The courts have interpreted that to mean that a claim against the United States must be a monetary claim or a claim for property. And there is no such thing in this case.

Representative HOLIFIELD. All right.

Mr. SIGAL. There is another section of the law, 281 of volume 18 of the code, in which it is stated that it is a crime for an officer or employee, a Congressman and other persons, to receive or agree to receive compensation for services rendered or to be rendered in relation to a proceeding in which the Government has a direct or indirect interest. That applies to the receipt of compensation; not the question of whether there should be assistance in claims, but whether they should do this for compensation.

Mr. Price's letter to me said nothing about compensation. That was not the issue in the letter at all. The question whether they should testify or not—

The law as I pointed out is clear that as far as sections 283 and 284 are concerned, they apply to claims against the United States, and 281 applies only to receiving compensation.

Representative HOLIFIELD. Well, maybe Mr. Price was referring to a different kind of conflict of interest. Maybe he meant that if an employee came and testified in any way which was considered to be detrimental to the Commission's action, that would be in conflict to his future interest in having a job with the Atomic Energy Commission. Maybe that type of conflict of interest was meant.

Mr. SIGAL. Well, we do not know. That letter was not clear.

Representative HOLIFIELD. And I might consider that temporarily on the basis of a full-time employee. But in the case of a consultant who comes in and offers his professional services on a $50 per diem basis to the Commission, for the Commission to intimate that there would be a conflict of interest in his case could only mean that he might not be hired for additional consultations at $50 a day. Because that is the only conflict that there could possibly be, in view of the fact that no moneys are involved and no official acts of a government for compensation are involved.

Mr. SIGAL. It may well be that he meant that, though that was not specifically stated. I certainly do not think it is an unreasonable inference. However, we did not draw that inference. We said that in our opinion this was intimidation of a more immediate and threatening kind.

Well, in any event, my letter to the Chairman of the Commission drew a response from Mr. Fields, the General Manager of the Commission, and on January 25 he wrote to me as follows, in part, and I will quote here the major part of that letter:

We do not wish AEC employees to appear voluntarily as witnesses for a party at hearings before AEC because we believe that it would not be in the public interest for such members of the agency staff to become identified in this way with one side or the other. Particularly, we do not wish these employees to receive compensation for their testimony or to participate outside the scope of their official duties in the preparation of any party's case. These rules serve also to assure that the testimony of AEC employees will be equally available to all parties; that a party with limited financial resources will have opportunity equal to that of parties having greater resources to utilize AEC employees as witnesses; and that Commission employees do not violate the conflict of interest laws. I think you will appreciate that without such rules public confidence in the integrity of the Commission's staff might be jeopardized.

In advising that AEC employees may appear in response to subpenas, we felt that we should reserve the Commission's position to make appropriate objection in particular instances where such objection seemed warranted.

I might state here that there are no circumstances, it would seem, under which such would appear warranted.

Hence, we stated that "employees may appear in response to subpenas, subject to any direction of the Commission in regard to such subpenas." In limiting employees appearance to instances where they are properly subpenaed, we have no intent to preclude appropriate conferences between the party and the witness respecting the testimony which the party desires to adduce from the witness * * *

We believe that it is desirable to call our consultants' attention to the conflict of interest problem, particularly in view of the possibility that they might receive compensation from a party to a proceeding and that the matter involved might be one in connection with which they had performed services under their consultant agreements with the Commission. * * *

Mr. Price's letter of December 14, 1956, did not mean to suggest, and I do not mean to suggest, that voluntary appearances as such are a violation of any provision of law. Neither of us is in any position to interpret the criminal code. Because of the possibility that under certain circumstances the activities of our consultants in connection with voluntary appearances might result in violations of the conflict of interest laws, we felt we were under an obligation to call their attention to those statutes.

Now, as I said, this letter introduces an entirely new matter. If the Commission were interested initially merely in the question of whether their employees received compensation, it was simple enough to say that in the letter of December 14. And there was not even an inference, and not by the furthest stretch of the most sympathetic imagination could you construe that letter to mean what this explanatory letter now says.

We think it is a specious and devious rationalization that comes too late to repair the damage. As a matter of fact, we do not know if any employee or consultant was even sent copies of this last letter to correct the initial impressions.

But, as a matter of fact, this letter actually compounds the initial damage. Now, we do not doubt the applicability of section 281 to employees of the Government—full-time employees—insofar as compensation is concerned. The crucial question is whether or not part-time intermittent consultants are employees or officers of the Government.

I have given serious consideration to what the law is with respect to part-time intermittent consultants, and we think there is little

doubt, in the present state of the law, that such persons are not considered to be officers or employees of the Government under the intendment of the law. And we cite the cases in support of that proposition. I will leave that for your consideration.

Looking at it in the manner most favorable to the Commission there would be so much doubt about the question that the Commission certainly had no right to place this problem before all consultants, so as to scare them. Why should consultants take a chance? Their only interest, if any, would be to give the facts, if we asked them to testify.

It would certainly mean nothing to them to refuse to testify. They are not personally concerned. So all it would take would be just a little threat, that is all. Just a statement that "you ought to consult your attorney before you do this." And they won't talk to anybody who might suggest that it might be advisable to testify for us in this hearing. Certainly this unsolicited legal advice was entirely outside any justifiable conduct on the part of any Commission officer.

At the very least we feel that Mr. Field's reply muddied further the waters into which AEC should not have stepped in the first place.

Under these circumstances, Mr. Chairman and members of the committee, we think this committee should immediately start a probe of the extent, if any, to which the Commission or any of its members or employees exercise the power or influence of AEC to prevent any persons, particularly those connected by way of contract or otherwise with AEC, from criticizing or opposing the actions of AEC.

That, Mr. Chairman, concludes my remarks.

The CHAIRMAN. Thank you very much, Mr. Sigal. I believe we notified you on January 22, asking you to give us a memorandum on the law, on the conflict in question.

Mr. SIGAL. And I have included that argument in this statement. I cited the cases, which I did not read. It is in this whole discussion, but the cases are cited on pages 10 and 11 of this statement, and the argument on the matter.

Representative HOLIFIELD. Mr. Sigal, you have presented a very strong case here, and a case on which I have had some informal information given me at different times, in that the CIO has been unable to get certain scientists and other people who might testify in regard to the safety feature of this to come before them, apparently because they were under some kind of duress or, let us say, fear of retaliation or something along that line. Is it your considered opinion—and, of course, I ask you to be careful in your answer on a case like this—is it your considered opinion that there has been a lack of willingness to appear as a witness and testify to the facts of the case on the part of some people?

Mr. SIGAL. Well, Mr. Holifield, as I indicated in my statement, it is very hard to make that statement, or to answer it positively in the sense that we could point out anybody who said that. Nobody said it to us. But for persons with any sensitivity, it is not difficult to get the reaction. And various veiled references were made to the position of the Commission on this. And, as I say, we are forced to conclude that this letter and the attitude of the Commission have had this kind of serious impact.

After all, this is very unique. Every nuclear expert in effect is beholden now, has been or expects to be beholden, to AEC for a substantial portion of his livelihood. The AEC is the major employer. If not the major employer, it is certainly the source of practically all the funds that are available to employ these nuclear experts. And it would take a man of extraordinarily strong personality and conviction, but, not only that, a man who is so certain of his position in the industry that he could defy the Chairman of the Commission, and say, "I will testify. I don't care what you think." There may be such men. As a matter of fact, we would not ask a man to jeopardize his future if there were any reluctance on his part because of this situation to testify. But in the very circumstances of the case, in view of the fact that this warning was so utterly unwarranted, so unjustified, and as a matter of fact contrary to the Commission's own statement of November 5, 1956, that the conclusion, we submit, of reasonable men is that this letter has had this kind of intimidating effect on those people. They were not witnesses yet. They were just experts. And they will remain experts. Whether or not they will be witnesses is something we have yet to determine.

Representative HOLIFIELD. We are aware that the scientific advisory panel apparently unanimously made a recommendation to the Commission that the safety factors of this particular type of reactor had not been proven, and therefore it was unsafe to go ahead with it. Now, for reasons best known to themselves, AEC ignored the recommendation of its own Reactor Safety Advisory Committee. Did you, at any time, contact any of the members of the AEC Advisory Committee and seek to enlist them as witnesses to come before the hearing examiner in this case?

Mr. SIGAL. If you will permit me, Mr. Holifield, I will answer the first part of the question. We have contacted them.

Representative HOLIFIELD. You have what?

Mr. SIGAL. We have contacted various members of the committee, of this Safeguards Committee.

Representative HOLIFIELD. Do you have any reluctance to discuss this, as long as it is before a hearing examiner?

Mr. SIGAL. I have reluctance to disclose identity of individuals; yes. Under the circumstances, I am reluctant to disclose their identity. I am not reluctant to discuss the issues involved in this case before this committee. But I would prefer, until the case has been heard, and we have put our case in, not to disclose the identity of the experts with whom we have had contact.

Representative HOLIFIELD. Now, let us get to the point of the exclusion of the pertinent issues that you think were involved. You say that this is clearly within their legal right, as a Commission, to preclude the points of discussion which you wish to bring up?

Mr. SIGAL. Oh, no. Perhaps I did not make myself clear. I did not say that.

I said it is not within their legal right, once they grant a hearing. Having granted a hearing they have no right, as we see it, to exclude basic issues.

Representative HOLIFIELD. Did they exercise this right, or did the hearing examiner exercise this right, of preclusion?

Mr. SIGAL. Oh, they did. The Commission itself.

Representative HOLIFIELD. The Commission itself told the hearing examiner what lines of inquiry he should entertain?

Mr. SIGAL. Yes. Well, it did not tell it to him directly in that way. It issued an order first, an order dated October 8, 1956, in which it set forth the issues, specified the issues, which would be considered in the hearing. And it listed them as I indicated earlier. And then subsequently, when we challenged the matter of this limitation of issues, the Commission again, in another order, a later order, said very specifically:

> The only matters on which you can present evidence, which you can discuss before the examiner, are the matters we set forth in our order specifying the issues, and nothing else.

The CHAIRMAN. Did they formulate a rule on that?

Mr. SIGAL. Yes.

The CHAIRMAN. Could they take it up later?

Mr. SIGAL. They said the only thing that they might consider later would be argument. They said they might consider it later, that after the case before the examiner was closed, they might consider the question of whether or not AEC had the right to issue the permit under the circumstances. But they would not permit us to present any kind of evidence or argument before the examiner on the matter.

Without any investigation into the question of whether we had any argument or evidence to present to the examiner, they precluded the examiner from accepting any kind of argument or evidence on those issues.

Now, the only hope it gave us is that it might listen to argument at the time the matter has already been closed before the examiner.

Representative HOLIFIELD. Well now, where would they listen to this argument—before the examiner, or privately?

Mr. SIGAL. Yes; as a matter of fact, we think, and it is our contention that the basic issues that we have raised will not get consideration. We think the basic issue is not—although it is an important issue—whether this particular reactor is safe. That is very important, and that is our whole case before the examiner, as to safety and the financial qualifications. But the matter I present to the committee now goes to the overall conduct of the Commission with respect to its administration of the law and its issuance of licenses in general.

Now, if they can be as capricious generally as they were in this case, and there is no forum before the Commission before which to raise the point, we say there will be very serious damage to this entire program. And we think it is a matter which requires the immediate attention of this committee and the Congress, because we can expect more licenses to be issued, far more than there have been, particularly under the pressure of the proposals that have been made before this committee and before the Congress.

Representative HOLIFIELD. Of course, I agree with you that the whole procedure of licensing and regulations should be thoroughly explored, and I think it is this committee's prerogative and jurisdiction, and possibly its duty, to go into this very important point.

At this time I would like to ask you this further question. Now, assuming the examiner's hearing is over and the brief has been submitted to the Atomic Energy Commission, what result could occur? Does the Commission have to make a decision on the basis of that

field of evidence which has been submitted to it, and publish an open statement on it? Can they ignore it, and refuse to make any kind of a decision? What is the procedure?

Mr. SIGAL. Well, the procedure will be that after the hearing is closed, completed, the transcript will be transmitted to the Commission, and then briefs will be filed. We may get no oral hearing before the Commission after the hearing is closed, And, of course, I suppose the Commission feels if we want to put something into our brief on the subject, we can put it in. There is no stopping our typewriters. But whether or not they will consider it is something we have no assurance about, and we certainly have no assurance that we will be heard by the Commission after the evidence is in—heard on the issues which I have just mentioned.

Representative HOLIFIELD. As I understand it, under the Administrative Procedures Act, when the hearing is closed the examiner makes a recommendation to the Commission; is that right?

Mr. SIGAL. Well, that is the usual procedure. However, in this case the Commission did not give the examiner that right. In this case the Commission said that the examiner shall not make any recommendations but simply transmit the record, the transcript, to the Commission. However, the examiner, of course, conducts the hearing. He is the one who makes rulings on evidence. He determines what can go in and what will be excluded. So he has, of course, very substantial powers with respect to the conduct of the hearing and what will constitute the transcript for consideration by the Commission, and later by the courts.

Representative HOLIFIELD. Operating in the narrow field of inquiry which they have prescribed, and with the further right to accept or reject evidence within those narrow fields, it is possible that a very narrow case might be placed before the Commission finally. Is that your contention?

Mr. SIGAL. Well, as to your last detail, I do not think they can ignore it. This is the first hearing of its kind, and I doubt that they are going to ignore it.

Representative HOLIFIELD. I am not saying that they will, but I wonder if they have the power to. Under the Administrative Procedure Act, are they compelled?

Mr. SIGAL. They are compelled to make a disposition of the case, compelled in this sense, that the law and the regulations, the regulations more specifically, do provide for the issuance of a decision. Now, obviously, they could delay it for many months and years if that was their inclination. We do not anticipate any such thing.

Now, the problem is: What kind of a decision have they left themselves open to make? They have already indicated what they have left themselves open to do, and I have quoted the language, in which they say,

What we did on August 4, 1956, has nothing to do with the case.

We say it has everything to do with it. They say it has nothing to do with it, and they have already said that. And the only thing—and they have already said it—that we will consider is as of the time the hearing is closed. That might be several months from now.

We will consider the situation as of that time, and as of that time we will determine whether or not reasonable assurances of safety of operation can be

given, and as of that time we will determine whether or not the company has the financial qualifications necessary.

We say, and their own regulations say, that the determination should have been made on or before August 4, 1956, not August 4, 1957, or some other date.

Representative HOLIFIELD. All right. I follow you to that point. Now, what recourse do you have from the legal standpoint, once having gone through the administrative procedures?

Mr. SIGAL. Well, we assume we could go to court to get review of the action of the Commission.

Representative HOLIFIELD. But in that case you would be denied the presentation of your case on the merits, and you would be confined only to the evidence that was put forth in the administrative hearing; is that not true?

Mr. SIGAL. Exactly. We would be confined to that.

Representative HOLIFIELD. Your answer is to the affirmative?

Mr. SIGAL. Yes. So far as evidence is concerned, we could not subsequently introduce any evidence.

Representative HOLIFIELD. You cannot introduce and argue the case on its merits in the court. You must argue it on the evidence presented in the administrative procedures hearing?

Mr. SIGAL. Exactly. If the court should determine that we were illegally denied an opportunity to present evidence, then they would send the case back and start this grind over again. So that, by 1960, we may get a decision on this case.

Now, we do not think that this is the kind of conclusion that the Congress contemplated in this matter.

Representative HOLIFIELD. So your contention essentially is this: That because of the limitation of subject matter which has been imposed upon you in this hearing, and because of the limitation of further court action as a followup to the administration procedures hearings, you are now asking this committee to exercise its jurisdiction and go into this matter thoroughly?

Mr. SIGAL. Yes. Now, if I may amend, I think your statement is probably a little more general than I would make it. We are not talking about any limitation of our right to present evidence. There are obviously matters of degree, and we won't challenge the right of the Commission, say, to exclude what may be trivial issues. But these are not trivial. This goes to the heart of the business. And if the Commission can say they won't consider matters of this consequence, I frankly do not think there is any issue of consequence that they could say cannot be ignored. Because these we consider to be the most important issues before the Commission in any case, in any licensing procedure. There are no more important issues than these two with respect to the granting of a particular license.

The CHAIRMAN. Mr. Cole.

Representative COLE. I frankly cannot get seriously disturbed about the Commission excluding the taking of testimony which went to the question of the legality of the actual Commission. Because is it not the purpose of the hearing examiner to elicit facts rather than questions of law? You do not need evidence to determine the Commission's legal authority. You do not need any facts pro or con one way or the other that are not on the record.

Mr. SIGAL. How could anybody say that, Mr. Cole?

Representative COLE. How could anybody say that?

Mr. SIGAL. How could anybody say that you do not need facts to determine the law. The law is governed by the facts. And we think the examiner should be given the opportunity to receive anything that is relevant to anything that is before the examiner in the case.

Now, what the Commission has done is to exclude these issues.

Representative COLE. Excluded from the examiner?

Mr. SIGAL. It has gone further, Mr. Cole.

Representative COLE. No need to get into argument about it. I am curious to know what your reaction would have been had this reactor been built out there by the Atomic Energy Commission?

Mr. SIGAL. What recourse we would have had under these circumstances?

Representative COLE. What would you have done?

Mr. SIGAL. Well, Mr. Cole, so far as we know, the Commission has never done that.

Representative COLE. I am asking you what you would have done if the Commission had gone out there and started to build this same reactor.

Mr. SIGAL. Ignoring the safety considerations?

Representative COLE. Under the same conditions.

Mr. SIGAL. We would certainly have tried to find the appropriate legal procedure to stop them. Indeed we would, Mr. Cole. Because our interest is in the safety of the people in that area.

Representative COLE. That is far enough. Then you would have pursued your position as aggressively in case this reactor was sponsored by the Government through the Atomic Energy Commission as you have pursued it since it is under private sponsorship?

Mr. SIGAL. We do not think the Government has any right to violate the law, any more than private individuals have. But we say the Government is violating the law. That is our point. The violation does not consist in the building of the reactor. They are not doing that, except in part. But the Government is violating the law. Because the AEC is the Government. The AEC is violating the law by granting this permit.

Now, the question of who builds the reactor is not the question. The question is: Is the AEC violating the law? We say the Government is violating the law.

Representative COLE. That may be your opinion. And I do not agree with you. But that is for somebody else, not you or me, to decide.

Another thing that troubles me is: How does it happen that out of millions of people who live in the Detroit area the CIO organization is the only one that is concerned about the safety and welfare of the folks living there? Why is it we do not have the same protestations from political representatives of those people—the city council, the mayor, the county organization, the State authorities? Are not those people concerned about the safety of the residents of the Detroit area? Tell me why it is that the CIO is the only one that is pointing this up.

Mr. SIGAL. May I first point out it is not the CIO. It is the AFL–CIO.

Representative COLE. I understand that, but for the sake of brevity I just used that expression.

Mr. SIGAL. I will answer the question very briefly. I understand the next witness is going to go into that in greater length. But the question of—remember, it was a very short time involved here. We have only 30 days in which to challenge the action, under the rules. It requires persons who are themselves familiar with the laws and the facts to be able to move quickly. The regulations as they now stand put a premium on knowledge. Knowledge in this area is very narrowly restricted, Mr. Cole.

May I finish my answer, please?

Representative COLE. If you will, quickly.

Mr. SIGAL. Yes. This is not a short subject. The knowledge in this area is very narrowly restricted. We, as it happens, the unions involved in this case, have been in this picture for 10 years. We have followed it closely. We know a substantial amount of what is involved in here; not everything by a long shot. But there are not many people who know.

Representative COLE. I will concede your superior knowledge. Now let me ask you: Did you or anybody in your group go to the health authorities of Detroit and point out to them this possible hazard?

Mr. SIGAL. The health authorities of Detroit do not have any legal power, Mr. Cole, to move in the situation.

Representative COLE. They have the same power to intervene that you do; do they not?

Mr. SIGAL. Frankly, they do not; no. Because we can move, if we want to move. We do not have to get political action.

Representative COLE. Did you not go to the health authorities of Detroit and point out this matter?

Mr. SIGAL. Not to the health authorities of the city of Detroit.

Representative COLE. To the city fathers? The mayor?

Mr. SIGAL. They were certainly made aware of the danger. And they did not move.

Representative COLE. Were they made aware of the fact that you were in possession of special knowledge on this?

Mr. SIGAL. Let us assume they had it; yes.

Representative COLE. Did you go to the State authorities?

Mr. SIGAL. Let us assume we did, Mr. Cole.

Representative COLE. No, no.

Mr. SIGAL. I cannot answer all your questions. I am one lawyer in the case. I cannot answer it, in the first place.

In the second place, there is no obligation on us to ask someone else to do their job.

Representative COLE. I know. But what I am trying to find out is why there is no representation from these other organizations or institutions or authorities, which are equally interested in the health of those people out in that area, other than the CIO?

Mr. SIGAL. They are certainly interested, Mr. Cole. But the important point is: Who knows enough about it and has the equipment to go ahead? That is what is required, the know-how. We had the know-how, and they did not.

Representative COLE. Am I to understand the reason these other authorities have not expressed themselves in the same fashion that you have is out of ignorance or uncertainty or lack of knowledge of the problem?

Mr. SIGAL. I cannot speak for those authorities, Mr. Cole.

Representative COLE. I realize that.

Mr. SIGAL. I do not know their reasons. But may I point out that the lawbooks are just strewn with thousands of cases where some individual, one individual, represents the public interest. It is up to some individual who is sufficiently interested, who has the energy, who has the knowledge, who has the concern, to move.

Representative COLE. Would you not agree that the health authorities of Detroit, the city council, the county authorities in that area, even the State authorities, are equally interested in the health and safety of the people in that area, with you and your organization?

Mr. SIGAL. I am certain they are equally interested.

Representative COLE. Then if they have not moved, it must be because they were not fully aware of the hazard involved.

Mr. SIGAL. They may have been ignorant of the hazard.

Representative COLE. Or they were satisfied.

Mr. SIGAL. No. I will not accept that conclusion. They just did not know. If they had known of the hazard adequately, they would have moved, in our opinion.

Representative COLE. That is all, Mr. Chairman.

Senator ANDERSON. I wish to inquire into why they did not move. As a matter of fact, on August 4, I released a statement I had made in which I said the issuance of the construction permit "in my opinion sets a dangerous pattern in the early stages of AEC's quasijudicial activity for the following reasons * * *." I do not wish to go through them all, but I pointed out that, in addition to what I called "star chamber proceedings," the report of its Advisory Committee on Reactor Safety, which aroused grave doubts as to the safety of the proposed reactor, has never been made public by AEC—

> It is my understanding that this important report filed on June 6, 1956, which was prepared by a distinguished committee of experts, has not been retracted or modified by them.

Is it your understanding that as of that time, August 4, even though the report had been previously issued, the report of the Advisory Committee had not been made public?

Mr. SIGAL. Exactly, Mr. Senator. The report was not made public until 2 months later.

Senator ANDERSON. When I tried to make it public, is it your understanding that there was objection to that on the part of the AEC?

Mr. SIGAL. Yes; there was. And they as a matter of fact discovered a new classification of information. Not restricted, but "administratively confidential" was the label they put on this—as if that made it somehow restricted—although subsequently the Chairman conceded that it was not restricted information.

Senator ANDERSON. Now, when the Chairman of the Atomic Energy Commission made his statement to this committee, he said on page 28:

> The Commission also has enlarged its efforts to work closely with State agencies on the licensing program. Appropriate State agencies are notified of all licensing actions.

Has it been your understanding that all of the appropriate State agencies in Michigan were notified of this licensing action before the licensing action was taken?

Mr. SIGAL. Certainly not.

Representative COLE. Certainly not? They did not? Or it was not in your information?

Mr. SIGAL. My information is that they did not. I may be wrong, but that is my information.

Senator ANDERSON. Well, this is the second point I made on August 4, in my press release:

> While areas between Federal and State interests in safety and other matters have not been clearly delineated, the Governor of the State of Michigan has apparently been precluded from being heard or participating in any decision on this in the State of Michigan.

The Governor of Michigan had made that statement to me over the telephone an hour or two before I issued this press release. So that I know of my own personal knowledge that the Governor not only had not known about it but had been refused a copy of the safety reports, so that he could not make a judgment. Do you think it was the purpose of the law to prohibit the Governor of the State of Michigan from knowing what was in the report?

Mr. SIGAL. Certainly not.

Senator ANDERSON. Do you think it was the contemplation of the law that the first intimation he had of the law was when I read him sections of the law over the telephone?

Mr. SIGAL. Certainly not.

Senator ANDERSON. I do not think so either. Now, I think this whole suit, if you do not mind my saying so, has been put in the wrong framework. The action of the Atomic Energy Commission, and its rulings, has put the whole matter on the basis of the safety of this particular reactor, rather than on the procedures by which the permit was approved. Frankly I have hoped a test of the procedures might result from this lawsuit. I do not know anything about the safety of this reactor or the essence of it. A committee of very distinguished experts has said that they have some doubts about it. I do not want to say they have said it is not safe. I say they have expressed some doubts. I would like to see a procedure developed by which, when a responsible group set up by the AEC has doubts about safety, that fact will be transmitted not only to the Joint Committee on Atomic Energy in advance, but to the Governor of the State, to the health and welfare agencies of the State, to the mayor of the city of Detroit, if it is imperiled at all, and that they may thereafter have some knowledge on which they should base an intelligent action.

Do you think that is unreasonable?

Mr. SIGAL. I certainly do not. And I would like to point out, Mr. Senator, that the Government has been extremely careful, the AEC has been extremely careful, not to proceed in conflict with the recommendations of its Safeguards Committee with respect to any reactor which it built itself.

It followed their directions very carefully and explicitly and in detail. And that was shown by a release only a few days ago with respect to the boiling water reactor out in Chicago.

But when it comes to reactors built under this powder demonstration program, the AEC appears to have thrown this all to the winds, as

you can see by what happened to the Yankee case and what happened to this case, the first two cases to come up for examination.

Now, certainly the Safeguards Committee or whatever other committee is set up for the purpose, should have its recommendations more carefully considered in these private reactor situations.

Senator ANDERSON. Now concerning the letter Mr. Fields sent out: He said that "AEC employees may appear in response to subpenas, we felt that we should reserve the Commission's position to make appropriate action in particular instances where such objections seemed warranted."

Can you analyze for me what that sentence is intended to say?

Mr. SIGAL. I am sorry. I cannot. The Commission writer did not explain under what possible circumstances it would be warranted to prevent the witness from testifying, or what they meant. We simply have no knowledge of what they meant. The Commission would be in the same position as any other party who objects to the calling of a given witness, or objects to testimony that is asked for in that the time to do it is perhaps the time of the issuance of the subpena; but not at the time this was done.

Senator ANDERSON. The next sentence reads:

> Hence, we stated that "Employees may appear in response to subpenas, subject to any direction of the Commission in regard to such subpenas."

Mr. SIGAL. That is right.

Senator ANDERSON. Would you construe that to mean that the employee could respond, but the Commission could tell him what he would say in testimony?

Mr. SIGAL. Well, that is a fair inference. That is certainly a fair inference, that the Commission, whenever an employee is subpenaed—he would discuss the whole case with the Commission and be advised of the position he should take. That is not an unreasonable interpretation of that language.

Now, whether the Commission meant it, I do not know. But certainly it was their obligation to be clear in a situation of this kind.

Senator ANDERSON. But here we have two interpretations. One is that once the subpena is received, the Commission will then decide whether or not the employee will appear.

Mr. SIGAL. That is right.

SenatorANDERSON. If that is not the interpretation, it means that if the subpena is to be honored they should instruct him as to what he should testify.

Mr. SIGAL. That is right. Those are reasonable interpretations.

Senator ANDERSON. I am wondering: Does that strike you as the best way to elicit information from the witness?

Mr. SIGAL. I assume that is a rhetorical question.

Senator ANDERSON. I am trying to find out what is going to happen. We were trying desperately to obtain the information contained in that Reactor Safeguards Committee report. A little of it was put into the hearing in the House Appropriations Commitee. I read a little bit more of it, a few more paragraphs, that seemed to be somewhat innocuous, on the floor of the Senate. I was trying constantly to make sure that the Commission would deem it a public duty to release this report so that the public could decide whether or not they were endangered, by the construction of the reactor. We requested

a copy of the report, although I then had a copy in my possession. Yet I requested a copy so that the committee might release it.

When it was sent, it was sent with a tag on it—a tag I did not understand—which said, "This is administratively confidential."

Subsequently the Chairman of the Commission himself said that the tag was probably a mistake. I did not know whether he meant it was a mistake to believe that anything that was sent to this group would be regarded as confidential, or whether he thought it was a mistake to so classify it. This language is unusual. But I am trying to find out what an employee, if you subpenaed him, could tell to you. Could he not say "I will not appear unless I have my status clarified by the Commission"? Or would he say, "I will not testify until they tell me what I can testify to"? Do you know anything else he can do?

Mr. SIGAL. Obviously I cannot answer the question. We do know that there are certain Government agencies which instruct their employees not to testify—even in response to a subpena—on the ground that the information for one reason or another should not be revealed.

Senator ANDERSON. You see, Mr. Sigal, I imagine I am the only individual in the room who has had this peculiar and interesting experience, because, as a Cabinet officer, I received a subpena from the Senate of the United States one time to appear and reveal who were grain speculators. We finally worked it out, and I did appear without too much difficulty. But we did have a violation of law involved. The law said I must not reveal such information. The Senate resolved it by passing a law saying I might reveal the names of all speculators, and we got along all right thereafter. In the next paragraph of the Fields letter you quote:

> We believe that it is desirable to call our consultants' attention—

that means the employees of the Atomic Energy Commission—

> to the conflict-of-interest problem.

Now, what do you understand the conflict of interest to be, if a consultant testifies as to the safety of this reactor? What conflict can there be when a man tries to tell where the peril lies? Is it a conflict between the company which wants to built it and the Government, or is the company a part of the Government? What is the conflict of interest? As a lawyer, what would you say it was?

Mr. SIGAL. I think the possibilities you mention are certainly there. We construed this in the light most favorable to the Commission. We could have said, "You are suggesting things which go to the economic interest of the employees." We give AEC the credit for not thinking of those things. So we interpreted this in the narrowest way possible, or in a way most favorable to the Commission, and assumed that all they meant was that there was a possibility of a crime here. We could have indicated all these other grounds for possible conflicts of interest, the conflict of economic interests, the conflict between the employee and the order of his supervisor. Many other conflicts are possible.

Senator ANDERSON. I cannot quote the exact statute, but you and I know there is a statute which says that whoever increases the compensation of a Government employee, and so forth, violates the law. That is a rather candid statement, but I have had to tell many persons that if they accepted outside compensation for something they

were supposed to do, they would violate the law. That is the conflict-of-interest statute. But this apparently does not relate to that, because they did not know these people were going to be paid any money.

Had you offered anybody money to testify?

Mr. SIGAL. Nobody. At this time nobody was offered money for any purpose to give information.

Senator ANDERSON. Well, had anybody on the Atomic Energy Commission been offered money by your group for the purpose of testifying in this case?

Mr. SIGAL. No, sir; no money had been offered. That is why I say there was no possible excuse. That is why we said that that could not have been what was in the mind of the Commission. And if that had been in the mind of the writer, that item would have been mentioned.

Senator ANDERSON. So your effort was being made to get before the public the possibility of danger from a reactor which had not been sufficiently tested in the opinion of Reactor Safeguards Advisory Committee?

Mr. SIGAL. Exactly.

Senator ANDERSON. Now, is it in the public interest to publish that committee's opinion?

Mr. SIGAL. We do not know of any interest which could be greater than that for the public.

Senator ANDERSON. Then some other interest must have been involved which constituted the conflict. What other interest could that have been?

Mr. SIGAL. Well, perhaps we can only speculate on that point.

Senator ANDERSON. If you have a conflict, it must lie between public interest and private interest.

Mr. SIGAL. And the private interest, somebody's.

Senator ANDERSON. That was what was intended to be outlined in this Fields letter. I have never been able to understand the letter, I will say to you very frankly. I tried every way I could privately and publicly to get this safety matter released so that the people who were going to live near this reactor could form an independent judgment as to whether it jeopardized them or not. I realize that perhaps you should have communicated with the Governor of Michigan. But the Governor of Michigan had been thoroughly advised about this and had himself been unable to find out what was in the report.

Now, subsequently, when this whole matter became known, I imagine he was offered a chance to look at the report. It was pretty late by then.

Are you familiar with the fact that most of these large reactors being built in Great Britain are being built away from cities?

Mr. SIGAL. Oh, yes. I am familiar with the general situation.

Senator ANDERSON. Several miles away from the cities.

Mr. SIGAL. And it is also true of the United States reactors built by the Government.

Senator ANDERSON. There was no conflict of interest there?

Mr. SIGAL. No. That is true.

Senator ANDERSON. I think that is all.

The CHAIRMAN. Mr. Price?

Representative PRICE. Mr. Chairman, my recollection is, to get back to the subject about people other than the AFL–CIO being interested

in the hazard that may be involved here—my recollection is that we have some letters in our committee files in this connection. I think we have letters from two or three Congressmen who serve the area in which this reactor is to be constructed.

Senator ANDERSON. I think, Mr. Price, it is only fair to say that these people who tried to get information did not know how to start to get hold of it. The Governor of Michigan had no real way of finding out what was in the report, and he had no way of knowing whether the health and safety of the people of Michigan was being imperiled. Similarly, the mayor of Detroit was not able to find out about the peril.

Representative PRICE. I understand the protest on this runs a great deal of distance away from Detroit. Detroit, Mich., is not the only area from which protests have come. I understand they have come from Cleveland and the Toledo area. The reactor is located about midway between Detroit and Toledo, Ohio.

Mr. SIGAL. It is about equidistant.

The CHAIRMAN. At that time the hearing was in process, as you know, and we felt it advisable to state that we would hold a hearing there later on.

Senator ANDERSON. There seemed to be no way for the Joint Committee on Atomic Energy to get into the hearing; the hearing is between the United Automobile Workers and the AEC and, as they point out, the ground rules have been pretty well laid down as to what testimony they would accept.

Representative HOLIFIELD. Well, Senator, if I might ask you to yield at that point, I might say that if this committee decided to go into this thoroughly, I doubt very much if the AEC could lay down the ground rules in such a narrow fashion.

Senator ANDERSON. They could not lay it down for this hearing, but they could lay it down so that we could not get into the other hearing as a friend of the court. I explored that possibility.

Representative PRICE. Did we not have a request, where there was a Member of Congress living somewhere near a reactor, that we do go into it, that we hold public hearings?

The CHAIRMAN. And we answered that letter by saying we would not.

Representative COLE. I feel quite sure, Mr. Chairman, that Senator Anderson does not mean to leave the impression that the Joint Committee did try to inject itself into this proceeding before the Commission.

Senator ANDERSON. That is true. All I did was explore the possibility as to whether or not I could get in as a friend of the court to outline to the hearing examiner the difficulty that I had had in trying to make public something that I thought belonged in the public realm. And when I found I could not get in, I did not bring it to the attention of the Joint Committee. If I had found that it would have been possible for the Joint Committee to intervene in the public interest, I would have suggested that the Joint Committee try to effect that intervention. I think it was procedurally and completely wrong for the Atomic Energy Commission to grant a license in a star chamber proceeding which affected the welfare of everybody in the area, and then simply say, "It is an accepted fact now, and nothing can be done

about it. You can have your hearing, and when you get all through we will decide whether to heed testimony with reference to it."

I think for the sake of any reactor we are going to license in this country from here on out, once there is an application filed for that license and the Commission is about to grant it, the authorities in the State and in the city responsible for the health and welfare should be notified of the situation as to that application.

I fully believe that this reactor when constructed, if it is constructed, will be safe. I do not believe it will ever be allowed to operate until it is safe. I think that is fairly reasonable to assume. But nonetheless, it does seem to me—procedurally—that there should be some way that the public can learn before construction is approved, what is involved in that particular type of reactor.

Mr. SIGAL. That is an excellent suggestion.

If I may go on to another subject, in regard to the general subject of secrecy, we are confronted with that to a very substantial extent in this proceeding.

I have not raised it in this discussion, because at this time we are not prepared to assert that the Commission has done anything illegal in this hearing with respect to it. We have presented to the Commission a request for removing from the area of restricted data all information relative to civilian power reactors.

Now, there is a very substantial amount of information relating to this reactor, as well as to civilian power reactors generally, which are not available to any persons who have not gone through the regular clearance procedure, and do not have an access permit.

The CHAIRMAN. We are familiar with that. Thank you very much, Mr. Sigal.

Mr. SIGAL. I want to point this out, if I may, Mr. Chairman: that we have asked for a hearing from the Commission on that point. We have asked the Commission to remove the restricted classification from all that data on the ground that they have not properly applied the law. We filed that motion 4 months ago. We have not had a decision.

Now, all we have asked from the Commission was a hearing on the question of whether or not they have properly applied the law in keeping in the restricted area a very substantial amount of evidence which applies only to civilian power reactors. The Commission has given us no answer, and we think that in view of the position taken by AEC counsel, we will be denied a hearing. Now, if that does happen, I think this committee should look into the question of the application of this whole program in regard to restricted data to this civilian power reactor program.

The CHAIRMAN. Thank you very much, Mr. Sigal.

Mr. Freer is our next witness. He is personnel and insurance director of the Rural Cooperative Power Association at Elk River, Minn. You may proceed, please.

STATEMENT OF GAIL FREER, PERSONNEL AND INSURANCE DIRECTOR, RURAL COOPERATIVE POWER ASSOCIATION, ELK RIVER, MINN.

Mr. FREER. Mr. Chairman and members of the committee, my name is Gail Freer, and I am personnel and insurance director of the Rural Cooperative Power Association at Elk River, Minn.

I am appearing before you today to discuss some of our cooperative's problems and to present a statement, which I believe you have, from our president, Mr. O. N. Gravgaard, who was unable to attend because of a conflicting board meeting of the association.

Mr. Gravgaard asked me to convey to you his very deep appreciation for your interest in expediting this very important program and to bring the commendations of our board to you for the fine way you are going about it.

As you gentlemen know, our cooperative is one of three cooperatives which the Atomic Energy Commission has selected to construct an atomic powerplant. Ours will be a boiling water reactor of 22,000 kilowatts. The Rural Electrification Administration has already made the loan for the conventional turbine equipment, much of which is purchased today.

Our program cannot move regardless of how well our plant is designed and engineered until one most important problem is solved—that of insurance, which I would like to discuss at this time.

The major problems a licensee or contractor faces today are the amount of third party liability that is adequate and its cost, the cost of insurance necessary to protect the owner's other powerplant equipment and employees, and also loss of use of the powerplant. These are commonly described as third-party liability, physical damage, workmen's compensation and use and occupancy (cost of business interruption).

I have personally been in constant touch with employees and directors of the stock and mutual atomic insurance pools. Some rates have been established only as numbers, which are only guesses, and are subject to an infinite number of adjustments due to locality, type of reactor, and power level. The prices we have been quoted are completely impossible from the standpoint of economics due to the uncertainty and lack of knowledge of risks to be insured, with no previous experience to go on. We have with our attorneys, and with those of actuaries, reviewed the present suggested insurance indemnity bills and find many things desirable. The bills, as presently proposed, are not adequate to cover these problems.

The bills I have in mind are S. 52 by Senator Anderson and its companion bill, H. R. 888, by Congressman Price. In regard to third-party liability, these bills do not determine the amount of private coverage which must be taken by the atomic operator. The features of rate and indemnification are very good and realistic.

What I mean by that, Senator Anderson and Congressman Price, you set a rate in there of $30 a thousand of kilowatt thermal energy for heat. In our case we think it is a very realistic price because it comes up to what we are presently paying on the third-party liability at the present time.

The heat that you mentioned per thousand kilowatts of thermal energy at $30 a thousand, the rule of thumb there 30,000 kilowatts, we have a 22,000 turbine and 58 megowatts of heat energy from the reactor, if you have a 100,000 kilowatt turbine it probably would be in the neighborhood of 200,000.

So that the price is realistically in there and we want to say at this time that we thing it is a fair price that you have quoted in the bills. It appears quite unsafe to our cooperative or others not to know before-

hand what the actual cost of insurance will be for private companies and we feel this decision should be included in the bill.

We do not think this amount should be greater than what would be required normally for a conventional plant of equal size.

Senator ANDERSON. Do you mean by that legislation should fix the rate?

Mr. FREER. No. In Senate bill 52 it states:

> The Atomic Energy Commission when entering into agreements of indemnification with contractors may require its contractor to provide financial protection of such a type and in such amount as the Commission shall determine to be appropriate to cover public liability claims from nuclear incidents.

Senator ANDERSON. That particular language was worked out by the whole committee as a compromise. If we specify that the rate shall be $10 per thousand or $5 per thousand, then the company has the right to say, "We don't care for it at that price."

Mr. FREER. That is not what we are referring to, Senator. What we are thinking of is the power the Commission has to settle the amount of insurance that we must acquire from private companies.

Senator ANDERSON. May I explain to you that at the time language was being considered, the committee was informed that the maximum you might specify would be somewhere in the neighborhood of $65 million, $50 million from the stock companies and $15 million from the mutuals.

There was some question whether those were duplicated or not because the insurers had a maximum and they had offered part of it to the stock company, part of it to the mutuals and they might not have been able to take both of them.

In other words $50 million might have been the top limit for stock companies and mutuals put together. If you said to every company, "You must carry $50 million worth," we would have made it impossible for your little cooperative to have functions.

Therefore, the committee—I hope I am not speaking amiss for the committee—but at least one member of the committee believed that if you said the limits should be what the Commission itself might feel was reasonable, the Commission might say to the university which is operating a research reactor, "You have all the requirements by carrying the $50 million base," because the likelihood of a very serious accident would not be great.

A small utility—I hope you do not mind my referring to yours as a small utility—a small utility might carry, to use an arbitrary figure, $5 million insurance because it would be operating a small reactor.

The possibility of explosion might not be great and, likewise the destructive potential might not be great. The reactor might be located in a sparsely settled area where damage to great skyscrapers could not exist.

If the utility carried the $5 million, then an additional $5 million would make good coverage. If you insured Consolidated Edison in New York, Commonwealth Edison in Chicago, you would have to have the full amount. The Commission would require the full amount the private companies were willing to assume and the Government would override only the risk above that. I respectfully disagree with you, but you will have to leave with the Atomic Energy Commission the decision as to how much basic coverage it is going to require before the indemnity or reinsurance becomes effective.

Mr. FREER. We feel that will retard the progress of atomic energy because of that.

Senator ANDERSON. In what way?

Mr. FREER. If the Commission would state you are required to have $30 million of coverage. Up until 2 weeks ago they had a rule of thumb of 1 percent per million and then they changed it to 1 percent on the first million, one half percent on the next 4 million, one-tenth of 1 percent on the balance.

So that when we are talking in figures at $30 million, of 100 to 200 thousand dollars a year insurance coverage, because we feel this covers third-party liability and does not cover the physical damage and workmen's compensation and some of the other ones.

One of the gentlemen testifying this morning spoke about workmen's compensation. There are only two States that have a set rule of thumb on workmen's compensation or any ruling or any law on it. Minnesota does not have one. They have a number but they don't know how much they are going to charge.

The last estimate we had, they thought they might take a $25,000 flat charge in addition to——

Senator ANDERSON. I do not follow you on your flat charge.

Mr. FREER. In other words, we will have employees other than the ones employed in the atomic reactor plant. In this plant they would charge a flat fee of $25,000 that they would take as a premium.

Senator ANDERSON. Over and above the regular rate.

Mr. FREER. Then, on the other employees you would have your regular—it happens to be $4.12 per hundred dollars of payroll in the State of Minnesota on 75–40 classification. That is the one they give REA cooperatives in Minnesota. So that we would pay $4.12 per hundred on our total payroll plus the $25,000 deposit premium that they would hold and then if our experience was good over a period of years, they would give us a rebate back on it.

Now, that we are a little concerned about. We were also concerned with physical damage, Senator. On this physical damage setup, if we go to $11½ million and they tell us they don't have a figure on it yet, but one of the fellows that is on the Board of this atomic energy pool quoted me 40 cents a hundred and that was only 3 days ago.

The CHAIRMAN. I am sure you are aware of the fact that the committee has already given notice that we are going to take up insurance and go into the details. You will be afforded an opportunity to state your views in full detail at that time.

Senator ANDERSON. I only want to say this: I think you have to start on the assumption that the Atomic Energy Commission is going to try to work out a reasonable solution of this for small companies. I am perfectly satisfied.

This is all pretty sketchy. I can remember the time in my firm when I did not underwrite cotton gins. They were hazardous. Now, I would be glad to underwrite all the cotton gins in the United States. These things will change in the same way with atomic energy plants. You may have to put the $25,000 premium up now, but as we get more experience with the operation of them, they will come back down to a reasonable figure.

I only say to you I know of no other safe place to leave this other than in the Atomic Energy Commission.

Mr. FREER. We agree with you, but the only thing we are concerned about, and I think it is the time and place to bring it up, too, because we are all concerned with the advancement of the art and trying to get the peaceful use of the atom on the road and we have not been making much progress with it up to now. As matters stand today no contractor or operator can start in an atomic plant without Government indemnification on an insurance program.

I do not think they could because the costs are prohibitive to economical operation.

Senator ANDERSON. But the British within the last year have finally worked out an insurance program so that coverage in Britain is not very difficult. The limits are higher than those suggested by the United States. They have seen the successful operation of the Calder Hall plant. That is what must be done to obtain an insurance rate that is reasonable. I think this will be the experience in this country.

Mr. FREER. I wonder if I may read three letters, Senator, that I have received from our insurers. They are fairly good-size companies. They all state the same thing, that in their opinion the problems—I will just read this letter.

We certainly appreciate having had the opportunity today to again discuss with you and Mr. Wolter the problem of Mutual Service insurance providing the Rural Cooperative Power Association with the necessary insurance to insure the atomic reactor program that you are contemplating.

We at Mutual Service are, of course, very conscious of the terrific contribution that atomic energy is making to mankind and we are specially proud that the Rural Cooperative Power Association is the first organization in this area to actively get into this field.

The problems that we have in supplying you with the necessary insurance are, of course, tremendous. We shall, however, continue to endeavor to work on the program so that at the time these coverages become necessary we will be in a position to provide them to you.

In our opinion the insurance industry cannot provide the necessary coverage required for third-party liability claims which may result from radiation. We feel that the only answer for adequate coverage is some program provided and underwritten by the United States Government.

We do feel, however, that each organization can be required to purchase a fixed minimum of third-party liability insurance from private insurance sources. This amount, of course, would have to be quite small compared to the total coverage necessary.

That is the sum and substance of this letter. One from the IRM people says:

Rapid strides have been made in the development of the atom for private use, and the insurance industry has been doing everything in their power to keep abreast of the times. They have filed underwriting rules for nuclear energy liability insurance through the National Bureau of Casuality Underwriters for Nuclear Energy Liability Insurance Association.

This is, as you know, a group of 134 stock insurors. I am sorry to advise that as of February, the filing had not been made for the State of Minnesota. However, it is their intention that this filing be made at a very early date.

This filing provides insurance up to $50 million per reactor, which includes reinsurance in foreign markets as is now being offered by the Nuclear Energy Liability Insurance Association. This permits protection well in advance of completion of any of the planned commercial nuclear power projects.

While the association can provide a fixed amount of $50 million coverage, this of course falls short of the necessary coverage to protect the insured for the third-party damages that may result.

One other point where there is confliction of opinion, not only among insurance personnel but also among attorneys, is whether or not physical damage coverage is included. It is the writer's opinion that it is not.

Only through combined private insurance and Government indemnification, could adequate protection be procurred. With private insurance providing up to $50 million coverage, and the Government indemnification providing the excess coverage up to $500 million, the cost would be substantial, thus, making it absolutely necessary for the Government to subsidize this cost.

I believe, with the joint effort of the Nuclear Energy Liability Insurance Association and Atomic Energy Commisson, together with Joint Congressional Committee on Atomic Energy, these insurance problems will be remedied.

One of the large boiler and machinery companies in these United States that takes care of about 90 percent of the utilities, as far as co-ops and generating plants, Mutual Boiler & Machinery Co., Waltham, Mass., sent a telegram:

As carriers of your boiler and machinery insurance we have great interest in your proposed atomic-reactor plant. Through the nuclear energy insurance pools we can offer coverage up to their capacity on physical damage including contamination on premises.

Due to contamination and all risk features insurance costs wil lbe substantially higher than for conventional coverage. Passage of Senate bill 52 or House bill 888 should do much to assist you and others in solving the problem of adequate protection for the benefit of all.

The CHAIRMAN. Does that complete your statement?

Mr. FREER. That completes the statement. Thank you very much for giving me the opportunity.

The CHAIRMAN. Do you want to include this statement you have here?

Mr. FREER. Yes; I do, Mr. Chairman.

Senator ANDERSON. Do you want these letters included, also, that are attached to your statement?

The CHAIRMAN. Without objection they will be inserted in the record.

(The statement and letters follow:)

STATEMENT OF GAIL L. FREER, PERSONNEL AND INSURANCE DIRECTOR, RURAL COOPERATIVE POWER ASSOCIATION, ELK RIVER, MINN.

Mr. Chairman and members of the committee, my name is Gail Freer, and I am personnel and insurance director of the Rural Cooperative Power Association at Elk River, Minn.

I am appearing before you today to discuss some of our cooperative's problems and to present a statement from our president, Mr. O. N. Gravgaard, who was unable to attend because of a conflicting board meeting of the association.

Mr. Gravgaard asked me to convey to you his very deep appreciation for your interest in expediting this very important program, and to bring the commendations of our board to you for the fine way you are going about it.

As you gentlemen know, our cooperative is 1 of 3 cooperatives which the Atomic Energy Commission has selected to construct an atomic powerplant. Ours will be a boiling-water reactor of 22,000 kilowatts. The Rural Electrification Administration has already made the loan for the conventional turbine equipment, much of which is purchased today.

Our program cannot move, regardless of how well our plant is designed and engineered, until one most important problem is solved—that of insurance, which I would like to discuss at this time.

The major problems a licensee or contractor faces today are the amount of third-party liability that is adequate and its cost, the cost of insurance necessary to protect the owner's other powerplant equipment and employees, and also loss of use of the powerplant. These are commonly described as third-party liability, physical damage, workmen's compensation, and use and occupancy (cost of business interruption).

I have personally been in constant touch with employees and directors of the stock and mutual atomic-insurance pools. Some rates have been established only as numbers, which are only guesses, and are subject to an infinite number

of adjustments due to locality, type of reactor, and power level. The prices we have been quoted are completely impossible from the standpoint of economics, due to the uncertainty and lack of knowledge of risks to be insured, with no previous experience to go on. We have with our attorneys, and with those of actuaries, reviewed the present suggested insurance indemnity bills and find many things desirable. The bills as presently proposed are not adequate to cover these problems.

The bills I have in mind are S. 52, by Senator Anderson, and its companion bill, H. R. 888, by Congressman Price. In regard to third-party liability, these bills do not determine the amount of private coverage which must be taken by the atomic operator. The features of rate and indemnification are very good and realistic. However, to us it appears quite unsatisfactory for our cooperative or others not to know beforehand what its cost of insurance will be from private companies, and we feel this decision should be included in the bill. We do not think this amount should be greater than what would be required normally for a conventional plant of equal size.

In respect to the problems other than third-party liability, it is our opinion the bill is not yet broad enough to cover physical damage; workmen's compensation insurance, an item we are very interested in for the protection of our employees and laborers; and use and occupancy.

We have been advised that insurance coverages of this type will be available, but the rates we have been quoted are astronomical figures and would make operation of the nuclear plant impossible.

As matters stand today, no contractor or operator can start an atomic power-plant without the Government's indemnification of all of these risks mentioned above. With the misunderstandings we have found prevailing among lawyers as to what is covered in these bills and what isn't, our board of directors would appreciate this committee's efforts to have these matters clarified and more distinctly set out in the bill.

I have attached hereto letters from the large insurance companies we deal with, attesting to these problems. It is our feeling that the Government should not be in the insurance business to any extent greater than is necessary to help provide operating experience necessary for insurance companies to promulgate a rate that is based on actual risks.

We do feel, however, from our experiences over 2 yars, that Mr. Andrson's Senate bill 52, with some minor additions that we have set forth above, should be approved at the very earliest time, and we urge this committee's recommendation.

MUTUAL SERVICE LIFE INSURANCE CO.,
MUTUAL SERVICE CASUALTY INSURANCE CO.,
St. Paul, Minn., February 20, 1957.

MR. GAIL FREER,
Insurance Director, Rural Cooperative Power Association,
Elk River, Minn.

DEAR MR. FREER: We certainly appreciate having had the opportunity today to again discuss with you and Mr. Wolter the problem of Mutual Service Insurance providing the Rural Cooperative Power Association with the necessary insurance to insure the atomic-reactor program that you are contemplating.

We at Mutual Service are, of course, very conscious of the terrific contribution that atomic energy is making to mankind and we are especially proud that the Rural Cooperative Power Association is the first organization in this area to actively get into this field.

The problems that we have in supplying you with the necessary insurance are, of course, tremendous. We shall, however, continue to endeavor to work on the program so that at the time these coverages become necessary we will be in a position to provide them to you.

In our opinion the insurance industry cannot provide the necessary coverage required for third-party liability claims which may result from radiation. We feel that the only answer for adequate coverage is some program provided and underwritten by the United States Government. We do feel, however, that each organization can be required to purchase a fixed minimum of third-party liability insurance from private insurance sources. This amount, of course, would have to be quite small compared to the total coverage necessary.

Through the various nuclear and atomic energy pools the insurance industry has facilities available to provide physical-damage insurance to your organization. We feel that an adequate amount of insurance in this area can be provided by private insurance sources and it is, therefore, not necessary for the Government to provide such coverage. In the interest of atomic science I feel, however, that it would be advisable for the Government to subsidize and provide funds to cover the private purchase of such insurance.

Please feel free to continue to call upon us and we shall make every endeavor to work with you on an insurance program.

Very truly yours,

ROMAN N. ELLER,
Vice President, Sales Underwriting.

J. A. PRICE AGENCY, INC.,
Minneapolis, Minn., February 22, 1957.

Re Private and Government insurance.

Mr. GAIL FREER,
Rural Cooperative Power Association,
Elk River, Minn.

DEAR GAIL: Rapid strides have been made in the development of the atom for private use, and the insurance industry has been doing everything in their power to keep abreast of the times. They have filed underwriting rules for nuclear energy liability insurance through the National Bureau of Casualty Underwriters for Nuclear Energy Liability Insurance Association. This is, as you know, a group of 134 stock insurors. I am sorry to advise, that as of February, the filing had not been made for the State of Minnesota. However, it is their intention that this filing be made at a very early date.

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While the association can provide a fixed amount of $50 million coverage, this of course falls short of the necessary coverage to protect the insured for the third-party damages that may result.

One other point where there is confliction of opinion, not only among insurance personnel but also among attorneys, is whether or not physical damage coverage is included. It is the writer's opinion that it is not.

Only through combined private insurance and Government indemnification, could adequate protection be procured. With private insurance providing up to $50 million coverage, and the Government indemnification providing the excess coverage up to $500, the cost would be substantial; thus making it absolutely necessary for the Government to subsidize this cost.

I believe, with the joint effort of the Nuclear Energy Liability Insurance Association and Atomic Energy Commission, together with Joint Congressional Committee on Atomic Energy, these insurance problems will be remedied.

Yours very truly,

DON R. MARTIN, *Vice President.*

WALTHAM, MASS.

GALE FREER,
Mayflower Hotel, Washington, D. C.:

As carriers of your boiler and machinery insurance we have great interest in your proposed atomic-reactor plant. Through the nuclear-energy insurance pools we can offer coverage up to their capacity on physical damage, including contamination on premises. Due to contamination and all risk features insurance costs will be substantially higher than for conventional coverage. Passage of Senate bill 52 or House bill 888 should do much to assist you and others in solving the problem of adequate protection for the benefit of all.

F. M. PORCELLA,
Vice President Mutual Boiler and Machinery Insurance.

The CHAIRMAN. Mr. Montgomery, I believe you are speaking for Mr. Reuther?

STATEMENT OF DONALD MONTGOMERY ON BEHALF OF WALTER P. REUTHER, PRESIDENT, UNITED AUTOMOBILE, AIRCRAFT, AND AGRICULTURAL IMPLEMENT WORKERS, AFL–CIO

Mr. MONTGOMERY. My name is Donald Montgomery. I am director of the Washington office of the United Automobile Workers, Mr. Reuther was unable to make this because of his very busy schedule.

He asked me to come up and present a statement for him and to submit to questioning on his behalf if the committee desires.

The CHAIRMAN. Thank you, sir; we are glad to have you. You may proceed. Do you have a statement?

Mr. MONTGOMERY. I have a prepared statement here.

In January of last year I filed with this committee, as a member of its Panel on the Peaceful Uses of Atomic Energy, a separate opinion in which I urged your committee—

> to institute early inquiry in order to determine how far and how fast private enterprise can and will assume the full risks and burdens of getting us over the hump and onto the highroad of practical nuclear power.

You reported favorably on the bill by Senator Gore directing the Atomic Energy Commission to build full-scale demonstration power reactors which, while supplying power to AEC installations, would speed the acquisition of the knowledge and experience that is needed to bring an atomic-power industry in this country into being.

In the opinion I filed with you I stated my belief that private enterprise would not be displaced, but would be substantially benefited, by more vigorous Government action—and in two ways: By more rapidly developing this new industry to the point where genuine opportunities will arise for the profitable investment of private capital and by enlarging the immediate opportunity for American manufacturers and engineers to design and build reactors and reactor components.

Six days ago your committee heard testimony from an American manufacturer, Chauncey Starr, vice president of North American Aviation, Inc. He so closely supports my position on this point that I cannot refrain from setting down, in parallel, his remarks and mine on this subject. Those parallel statements are attached to the prepared statement as exhibit I. (See p. 504.)

Starr told you, as I did, that full-scale-demonstration reactors must still be considered as experimental plants. He told you, as I did, that the economics of the electric-utility industry do not permit it to support the kind of national effort that is required.

He arrived consequently at the same conclusion I did—that sound national policy requires Government support of this new industry until economically competitive nuclear powerplants have been developed. And he added the important footnote that the kind of Government initiative which he proposes for this "infant industry" is not new in the industrial history of America.

I daresay it has been brought to the attention of this committee that the Atomic Industrial Forum recently conducted a poll among manufacturers, construction engineers, utilities, and various groups who are interested in this atomic-energy industry, to ask them what were the obstacles to the development of this new industry. Lack of economic incentive received the highest vote from these people who are in the business and who are directly concerned with it.

This confirms what Mr. Starr said and what Mr. Reuther said in the opinion he filed with you last year.

The Gore bill was defeated. We have had 1 more year under the policy promoted by Chairman Strauss and endorsed by the Eisenhower administration. The lag between progress in this country and in Britain and Russia has widened. They have expanded their atomic-power goals. We appear less and less likely to achieve even the inadequate goals that have been established for our country.

Russia, we hear, is planning to have between 2 and 2½ million kilowatts of installed nuclear electric power by 1961. The Moscow radio claims Russia has captured nuclear fusion for peaceful uses. These reports may be true or they may be false. They may be closer to the truth than we like to admit. No doubt it is still fashionable in the high councils of our Atomic Energy Commission to ignore that any scientific and technical progress in Russia exists.

There are reports from Britain which cannot be disregarded. Sir Edwin Plowden, Chairman of the United Kingdom Atomic Energy Authority, said last September that the 12 nuclear power stations they will build by 1965 will each deliver between 200,000 and 300,000 kilowatts of electric power—a total of between 2.4 and 3.6 million kilowatts.

The magazine Nucleonics for February carries a news note from London saying that the United Kingdom Atomic Energy Authority is expected momentarily to announce a greatly enlarged goal of between 6 and 7½ million kilowatts by 1965.

I might just add there that the rate of expansion which Sir Percy Mills, the new Minister of Power in the British Government, said they are working on will give them between 45 and 65 million kilowatts of installed capacity by 1975.

There is also information from England indicating that the high councils in AEC had better give up the fashionable notion that these British atomic powerplants are obsolete. The Britains said they would put nuclear power on the line October 17, 1956; and they did. They are now saying that their gas-cooled reactor is proving far more economical than they had expected and will soon be so fully competitive with conventional powerplants that within 10 years no more conventional plants will be built. Plowden says 7-mill power is already in sight.

Plans and programs announced by AEC for the United States add up to a total of 1.3 million kilowatts of installed nuclear electric power by 1964. The figure is far below the reported goals of Russia and United Kingdom, but what is worse, the chances that even this small goal will be reached have been growing dimmer throughout the past year.

Rumors of doubts and indecisions on what to do about construction costs much higher than anticipated are heard with regard to the Consolidated Edison, Commonwealth Edison and Elk River reactor projects. The Yankee Atomic Electric project has received what would appear to be a solid setback at the hands of the General Accounting Office.

The Consumers Public Power project is said to have run into double the construction costs it had estimated, and the experimental reactor, sodium reactor experiment (SRE), on which it waits to prove out its design is now more than a year overdue.

The Pennsylvania Power & Light and the Wolverine Electric projects are no doubt pushed further into the future by the corrosion problems encountered in the homogeneous reactor test at Oak Ridge.

These 7 projects account for 700,000 of the 1,311,000 kilowatts of electric capacity claimed for the United States by AEC. Eleven reactors on the AEC list have announced startup dates for 1960 or earlier, with total capacity of 753,000 kilowatts. Only 6 of these, with 254,000-kilowatts capacity, still appear to have any chance of going critical by 1960, and only 60,000 to 76,000 kilowatts of this capacity really seem likely to be on the line by that year.

How valid this pessimistic appraisal of the outlook—admittedly it's based on hearsay—maybe your committee, of course, can determine more accurately than we can. This, I believe, it should do. If, as appears quite possible, the prospect for practical nuclear power in the United States has distinctly deteriorated during the past year, this should be known. Some time ago we suggested that AEC is substituting propaganda for performance in the atomic power field. If now the glitter is wearing off the propaganda, and the dull unpleasant truth is coming to light, we ought to know it.

Another development of the past year that threatens injury to the entire atomic power program was the issuance of a construction permit for the Power Reactor Development Co. (Detroit Edison) reactor at Lagoona Beach, Mich. Development of a successful fast breeder reactor would mark a great advance in the art and should be pushed vigorously, of course. But as the AEC Advisory Committee on Reactor Safeguards said with respect to it:

> The Committee considers it important that bold steps be taken to advance the development of the fast breeder reactor concept and commends the willingness of the Power Reactor Development Co. to risk its capital and prestige in advancing the development of this reactor concept. But the Committee does not feel that the steps to be taken should be so bold as to risk the health and safety of the public.

I would say even more. I would say that nothing could do more damage to the development of atomic power than to permit AEC to pursue policies with respect to public safety that will raise doubt about the integrity of this vital agency. When AEC issued a construction permit for a reactor proposal which its Safeguards Committee could not approve, on which the Commission itself could not and did not make a finding of reasonable assurance that the reactor can be safe or that the parties building it are financially responsible, on which construction was proceeding nevertheless with the approval of the AEC and with the acclaim of its Chairman, Lewis Strauss, grave doubts were raised, and we and two other unions filed petitions of intervention with AEC to seek to have those doubts resolved.

Mr. Cole has raised the question why only these three unions took this action. I would like to address myself to that.

In the first place, Mr. Cole, it is not at all novel for the UAW to be taking the lead on public issues. I could give you quite a long list of issues where we take the initiative, which are not direct bread and butter matters of our union, but we think they are of concern to the whole community and we very frequently act on such matters.

Another point is that there was only 30 days in which to intervene. If you had not taken action by the end of August or the first or second day of September you could not take the action that we took. On

the other hand, I do not agree with you that we are the only people participating in this case. We are the only ones that acted rapidly enough to intervene. I do not believe that we are the only ones who will demonstrate an interest in this case before it is over.

What other parties can now do when it comes to that point in the hearing is to come in and state their position with respect to it. I cannot and will not speak for any other organization, but several have indicated to us that they might very well do that.

Now as to the State of Michigan, Mr. Cole, if you have information that they are opposed to our action in this case or that they will not take a position in this case before it is over, you have information better than mine.

Representative COLE. Right there, let me assure you I have no information one way or another about any of the public agencies I have in mind.

Mr. MONTGOMARY. My last information from the Governor's office, which was unsolicited, but conveyed to me by somebody there, is that they have not yet firmed their position on this matter and that they are working on that problem right now to decide what their position will be.

Senator McNamara has told me that he has a great many letters from people expressing concern about this matter; therefore, I assume supporting the action we took. I am sure I could get you a great many letters from our headquarters office if it would interest you, showing the same interest on the part of a great many people. So all that has happened to date is that we who were attending to such matters were able to act within the very short time which was allowed in order to act at all, and that is what we did.

Representative COLE. You say there was only a short time and therefore that might have shut some agencies out and now you indicate the possibility that the State of Michigan might come in?

Mr. MONTGOMERY. They cannot come in as intervenors. They can come in as witnesses. I am not saying that they will or will not. I know the State of Michigan has made no decision they will not.

Representative COLE. How can they come in?

Mr. MONTGOMERY. They can come as witnesses before this hearing and express their opinions on this question.

Representative COLE. And any other representatives of any other public bodies?

Mr. MONTGOMERY. That is correct. And they may do so for all I know. I just wanted to dispel the picture which you apparently have in your mind that we are the only people concerned about this. That fact has not been established.

Representative COLE. It is a fact that you are the only one that has made a legal representation.

Mr. MONTGOMERY. That is right. We are the only ones that got onto this thing fast enough before the 30 days expired when you could do something specific about it.

Senator ANDERSON. As a matter of fact, if somebody objects to the issuance of bonds to build a new auditorium in a city, a person goes in and files a taxpayer's suit. The fact that one lone individual files a taxpayer's suit does not necessarily mean that thousands of other people that do not come in do not agree with him. You have to have some person to intervene.

In fairness to Mr. Cole I assume his questions were based on trying to find out what other groups had come in. I believe you probably misunderstood his real motive.

Mr. MONTGOMERY. Of course, as you know, the Governor tried to get a copy of this Advisory Committee report, and it was denied to him. The time for filing or intervening had expired before he saw it. He did not see it until it was published on October 8 as a result of the action we had taken.

I think any elected officials, such as you gentlemen, know that the desire to bring new industry into your area is a rather strong one. The city of Detroit has been losing industries. I can well understand, and I am just guessing, that city officials hesitate to take action indicating they might look with disfavor upon a new industry, especially such a new thing as the atomic energy industry, coming into their State. Certainly Walker Cisler, the promoter of this project, has not been idle in conveying to the general public that this is the greatest thing that has ever happened for the State of Michigan.

Absence of Advisory Committee approval and inability of AEC to make the findings of reasonable assurance which the law and its regulations require alerted us to the possibility that an experiment is being conducted within 30 miles of Detroit and 20 miles of Toledo—a 300,000-kilowatt experiment on a novel, unproven, and hazardous type of reactor.

As to that statement, "hazardous type of reactor," I have quoted in exhibit II (p. 506) statements from Chairman Strauss, Commissioner Libby, Mr. Davis of the AEC Reactor Division, and Stuart McLain, program coordinator at Argonne National Laboratory, all supporting, I would say, my use of that word—a hazardous type of reactor.

Not only are we properly concerned with public safety in this matter, we are concerned also with the effect on the whole reactor program of a policy which disregards safety regulations and leaves prospective participants in the program exposed to the caprice and discrimination of the Commission.

With the case now before an AEC hearing officer, this is not the time to discuss its particulars. I would like, however, to take this opportunity to dispose of the charge that our intervention was motivated, not by a concern for safety, but by a desire to block private enterprise with the hope that this would advance the cause of public development.

I have already stated my views that more vigorous government action in this field will advance, not retard, the interests of private enterprise. With respect to our protesting the Detroit Edison reactor, I wish to call your attention to the fact that construction permis were issued for two other reactor projects during 1956, neither of which have we seen any reason to question. They are the Consolidated Edison project near New York and the Commonwealth Edison project near Chicago. Both of these are private enterprise projects, far more so, in fact, than the Detroit Edison project which leans heavily on government subsidy. Both received the approval of the Advisory Committee on Reactor Safeguards. And on both of them AEC was able to, and did, make findings of reasonable assurance of safety and of the financial responsibility of promoters.

That statement is taken from a press release issued by the Atomic Energy Commission in May of last year and I am sure that it is in

the files of the committee, where it said with respect to both reactors that they had the approval of the Advisory Committee and that the Commission had found the reasonable assurances which its regulations require it to find.

While I am on that point I would just like to point out that the release issued by AEC when the construction permit was issued for this Lagoona Beach reactor had this to say about the Advisory Committee:

> Issuance of the conditional construction permit followed an extended study of the design features of the reactor relating to safety and of reports by the Commission's Advisory Committee on Reactor Safeguards.

That is the only reference to the Advisory Committee on Reactor Safeguards. I submit that is a deliberate effort to make the public believe that the Advisory Committee had approved this reactor.

Representative COLE. What did you think when, in that announcement, they said this is a conditional permit?

Mr. MONTGOMERY. Of course all these permits are conditional. There is nothing unusual about that.

Representative COLE. You know they are not all conditional.

Mr. MONTGOMERY. Oh, yes, they are.

Representative COLE. All right, that is news to me.

Mr. MONTGOMERY. All under 50.35 are conditional. So is Commonwealth Edison's permit. So is Consolidated Edison's, all issued under section 50.35 of the regulations. I suggest you read them.

I want to make this further point about private enterprise—about 2 private-enterprise reactors, 1 at Lagoona Beach and one at Dresden, Ill., the Commonwealth project.

Let me give you a brief comparison of the vastly different backgrounds of the Commonwealth Edison boiling water reactor at Dresden, Ill., near Chicago, and the Detroit Edison fast breeder reactor at Lagoona Beach, near Detroit. Both are private-enterprise projects, but the Commonwealth Edison project is proceeding like a responsible private enterprise might be expected to proceed.

Compare the ancestry of these two reactors:

Great-grandparents

For the Dresden reactor.—A whole family of boiling-water experimental reactors known as Borax, successfully tested at the Idaho testing station.

For the Lagoona Beach reactor.—Inconclusive tests on the experimental fast breeder reactor, Clementine, at Los Alamos which corroded and was abandoned; followed by the experimental EBR–I reactor which from the first showed operational anomalies and finally got out of control and melted down.

One of the Borax reactors was exploded, intentionally. The EBR–I meltdown was not intentional; it was an accident. To this day its inherent instabilities are not understood.

Grandparents

For the Dresden reactor.—Experience to be drawn from operation of the 20,000-kilowatt EBWR at Argonne which went critical in December.

For the Lagoona Beach reactor.—The 62,000-kilowatt EBR–II to be built at the Idaho testing station will not go critical until midyear 1959, 6 months after design freeze of the Lagoona Beach reactor.

Parents

For the Dresden reactor.—Despite many tests and favorable experience with boiling-water reactors, General Electric is building a small pilot model with core of the same characteristics and nearly identical fuel elements to conduct fundamental tests required for the Dresden reactor.

For the Lagoona Beach reactor—No pilot model.

Since this was written I received from Argonne National Laboratory a release dated February 9, 1957, at the time they celebrated the successful completion of this experimental boiling water reactor (EBWR). I would like to read a few lines from that in order that the committee can see the contrast between this particular project and this fast-breeder project at Lagoona Beach. It says:

> In the United States the safety aspects of nuclear reactors are a matter of paramount importance. This is particularly true in the case of power reactors such as the EBWR that are erected near densely populated areas. Before approval for construction of the EBWR was given by the Atomic Energy Commission, the detailed plans of the facility had to pass a most rigorous examination by the AEC Advisory Committee on Reactor Safeguards. It is believed that the experimental boiling-water reactor is about as safe as it is possible to make it.

Now as to the ancestry of the Commonwealth Edison reactor—

> Boiling-water reactors have been shown by experimental means to possess an unusually high degree of inherent safety. Experiments in which large amounts of reactivity were added suddenly to a test boiling reactor at the National Reactor Testing Station, Idaho Falls, Idaho, showed that the reactor would eject such large amounts of water from the core, in a thousandth of a second, if necessary, so as to automatically shut itself down. Only after a great deal of complicated preparation was it possible to deliberately create a situation in which the reactor damaged itself.

That is the end of that quotation. That is the boiling water reactor.

The difference between these two reactors or their ancestry, the very good ancestry of the boiling-water reactor and the practically complete lack of ancestry, certainly the lack of any reasuring ancestry, for the Detroit Edison project, should make clear why we have seen no reason to challenge the permit issued to the Commonwealth Edison project. Through our intervention in the Detroit Edison case we hope to be able to clarify the issues of Government administration and public safety that are here involved.

As Mr. Sigal points out in his testimony, the hearings which AEC has ordered do not permit the legality of its action in this matter to be raised. The safety regulations and procedures of the Commission and how they are applied to various applicants may, however, be a subject of interest to your committee.

One more point in conclusion. You may have seen in a Sunday supplement magazine 2 days ago the story of Ben Zawacki. I have provided reproductions of it for the members of the committee, and I trust you will find time to read it if you haven't already.

There is one kind of question that the story does not answer, and in fact does not ask. Why was that pellet of cobalt-60 hanging there unguarded on an asbestos cord inside a 12-inch pipe? Was it in the possession of a construction contractor licensed by AEC to use radio-

active isotopes for radiographic work on the job, as 500 other contractors have been licensed? And if the contractor obtained this dangerous isotope under AEC license, what was he required to do to safeguard Ben Zawacki and all the other workers who know nothing about such things? And if AEC licensees are required to take precautions to protect wrokers from these lethal instruments, what had the AEC done in this case to see that the safety precautions were taken? Does it inspect the use of isotopes which it has dispatched to several thousand users for medical and industrial purposes?

I say, does the AEC inspect these isotope users at all? I do not know. I do know that in a report which the AEC filed with your committee, a report on manpower training programs, it is revealed that of all those enrolled in the AEC contractors training activities only 9 percent are training in the field of health and safety, and it reveals also that in the AEC training fellowships, there are only 30 people in training in industrial hygiene, and only 9 more out of 44 applicants have been selected for that training program in 1956–57.

"Now it has begun," Dr. Esposito said as they brought Ben Zawacki into the hospital.

It is a beginning; and is it not a beginning that your committee might wish to look into? I understand, of course, that you cannot investigate all the atomic accidents that occur. But the safety regulations, the procedures for enforcing them—if any, I might add—the inspection of jobs where radioactive devices are used, the number of inspectors available and the number being trained—these, I submit, are questions you might well inquire into at this point in time when, as Dr. Esposito said, "it has begun."

I close by quoting from a speech made to the Atomic Industrial Forum in September 1955 by Monro F. Pofcher, member of the AEC General Counsel staff from 1949 to 1953:

> It is important to realize, however, that realistic enforcement of Federal and State regulations will be most difficult. It will be perhaps startling to some but not to most of us in the atomic-energy field to be told that the great shortage of trained radiation safety officers makes it virtually impossible for either the AEC or the States to police radiation regulations effectively at this time. The AEC is clearly understaffed for this purpose and has, along with a handful in industry, almost all of the relatively few topflight men in the field. Few, if any, States can find many such men within their borders, let alone attract them into State service.

I submit this is a question which your committee certainly should give very close attention to. There are several thousand—I do not have the exact number—users of isotopes in health work and industrial plants, licensed by the AEC to use these dangerous instruments. The story of Ben Zawacki should alert us to the fact that we may not be paying the kind of attention to that new hazard that we should be paying.

Thank you.

Exhibits I and II referred to in text follow:)

EXHIBIT I

PARALLEL STATEMENTS ON THE NEED FOR GOVERNMENT CONSTRUCTION OF DEMONSTRATION POWER REACTORS

By Dr. Chauncey Starr, Vice President, North American Aviation, Inc.

In considering the manner in which the United States program for the development of atomic powerplants for peaceful purposes might be accelerated it is well to consider what is involved in the development of any one basic approach to atomic power. * * * [Here he speaks of the need for basic research and the construction of small pilot plants.] Of the many reactor types which may be tested in the pilot-plant stage, a few of the most promising should be selected for the construction of central-station size prototypes. These prototypes must still be considered as experimental plants because of the variety of technical and operating problems which must be explored. For example, the full-scale performance of reactor components, maintenance techniques, fuel reprocessing, waste-disposal techniques, the routines of operation and of fuel handling are some of the factors which will eventually determine the economic value of such plants and which can be developed successfully only on full-scale prototypes. The cost of such a program for any one reactor type will probably be between $50 million and $100 million.

GOVERNMENT SUPPORT OF PROGRAM MUST EXPAND

In view of the variety of approaches to atomic power which should be carried through the actual demonstration of prototype plants, it becomes a matter of national policy to provide the support for this development. Although the power utilities have undertaken partial financial support of these programs, it does not appear that the economics of the electrical utility industry, which is primarily concerned with the sale of power, would permit complete and continuous support of the required national development effort. It appears, therefore, that the support from the National Government, through the Atomic Energy Commission, must inevitably continue for some years as it has in the past, until economically competitive powerplants have been demonstrated. In spite of the hesitance of industry to accept the concept of direct

By Walter P. Reuther, President, United Automobile, Aircraft and Agricultural Implement Workers

In support of the panel's recommendations, I urge the Joint Committee to institute early inquiry in order to determine how far and how fast private enterprise can and will assume the full risks and burdens of getting us over the hump and on to the high road of practical nuclear power.

I make this supplementary recommendation because so much evidence has come to light that indicates private enterprise cannot reasonably be expected to shoulder so much of the burden in this development phase. Tremendous capital investments and development expenditures are called for. The chance of incurring major losses through unsuccessful design or early obsolescence are considerable. Neither AEC nor the manufacturers of reactors and components can give a utility system entering this field the kind of safety standards, performance guaranties and other assurances which bankers financing a private venture normally require. AEC will contribute substantial financial and other assistance, but the basic risk remains with the private participants. * * *

Manufacturers of equipment in this field have shown a great interest and undoubtedly have a vital contribution to make, but their experience and inventive qualities are brought into play only as they are engaged to join in the actual construction of a full-scale demonstration reactor. If the initiative in such construction is left in the hands of the private utilities at this stage of the program, the manufacturers' creative contribution will not be fully realized. * * *

The attempt by AEC to transfer prime responsibility to private enterprise at this time appears to be premature. If, as a result, we continue to encounter serious delay in nuclear power development, we shall be guilty of pursuing a doctrinaire "free enterpirse" approach to a problem which, at least for the present, is essentially national in purpose and scope and involves risks and losses of a magnitude which only government can reasonably be expected to incur.

EXHIBIT I—Continued

PARRALLEL STATEMENTS ON THE NEED FOR GOVERNMENT CONSTRUCTION OF DEMONSTRATION POWER REACTORS—Continued

By Dr. Chauncey Starr, Vice President, North American Aviation, Inc.

or indirect subsidy of industrial effort by the Government, it is appropriate that such support of atomic equipment development be accepted as sound national policy today. There are notable examples in the history of our country where Government support has opened new technical and geographical horizons, and has permitted the growth of strong industries and contributed to our national welfare.

This is an infant industry. The capital requirements are such that private means cannot possibly hope to supply all of the present needs for its development. This is not a new problem in this country by any means. The atomic energy industry today can be compared with many other industries which grew and prospered under our system of private enterprise through Government aid at the outset. An excellent example is our air transportation industry. In the early thirties, the Congress determined as a matter of policy that air transportation should be developed under the private enterprise system with Government aid. Without that policy, implemented as it was by congressional action, we would not have today the great air transportation system which this country enjoys in domestic operations as well as internationally. Moreover, the air transportation system has grown beyond the need of subsidy.

The same type of forward thinking should be applicable to the atomic energy industry today. There is no reason why we should depart now from the concept of private enterprise in this field any more than in the field of air transportation, the shipping industry, the mining industry, or the many other industries which obtained their impetus through Government encouragement.

By Walter P. Reuther, President, United Automobile, Aircraft and Agricultural Implement Workers

The development of large-scale reactors is, essentially, an experimental operation—as fully experimental as the construction of the small research reactors for which AEC is assuming the full responsibility and cost. If it is economically sound and proper for the Government to bear the burden of primary research in building the small experimental reactors, it would appear to be equally sound and proper for the Government to carry the major responsibility and risk in the second phase of experimentation—the building of full-scale demonstration reactors * * *

We do the utility companies no service by asking them to accept burdens which in view of all the unknowns in the present state of atomic technology they cannot finance as sound or normal business ventures. We do them no disservice when we ask the Government to recognize the national importance and scope of the task at hand, to carry the basic risk of this full-scale reactor development, while affording the designing and manufacturing segments of private enterprise full opportunity to make their valuable contributions to the program * * *

Only bold initiative by Government can accelerate needed progress and get full-scale reactors in operation so that the time lag between theory and practice can be minimized. Only when the Government has completed both phases of this basic research work of completing and getting into operation both the model reactors and the full-scale demonstration reactors, can we expect to get the influx of private risk capital and the resulting full impact of the dynamic qualities of individual initiative essential to carry the program to higher levels of development.

I hope that the ideological barrier will not be raised against my recommendation that the Joint Committee examine AEC development policy with a view to putting AEC to work building demonstration reactors, as the 1954 act already authorizes it to do.

Neither Government nor industry can do this job alone. It was the blending of the special contributions of each that provided the genius which gave America the atomic know-how to produce the first bomb. At this stage of our na-

EXHIBIT I—Continued

PARALLEL STATEMENTS ON THE NEED FOR GOVERNMENT CONSTRUCTION OF DEMONSTRATION POWER REACTORS—Continued

By Dr. Chauncey Starr, Vice President, North American Aviation, Inc.	By Walter P. Reuther, President, United Automobile, Aircraft and Agricultural Implement Workers
	tional atomic effort, nothing could be more tragic than to split our forces by engaging in a sterile and senseless fighting of ideological windmills. Our free enterprise system is not being challenged in America. If it were, less than 1 percent of the American people would support such a challenge, for the American people understand clearly that our free economy motivated by individual initiative and enterprise has given them a higher standard of living than any other people enjoy.

EXHIBIT II

In support of the statement that the fast breeder is regarded as a hazardous type of reactor in the light of what is now known about fast neutron reactors, the following quotations are submitted:

AEC Chairman, Lewis L. Strauss, testimony before House Appropriations Subcommittee, June 29, 1956:

The earlier testimony of his experts, he said, had shown that "this fast breeder was the most hazardous of all the reactors."

W. Kenneth Davis, Director, AEC Division of Reactor Development, testimony before same subcommittee, June 25, 1956:

"This use of fast neutrons does give rise to some safety considerations that are not presently found in some other types of reactors. One does have a greater possibility of getting a release of nuclear energy than one does in some of the other reactors I have mentioned. So on the safety point I think this is one reactor which deserves special mention."

AEC Commissioner W. F. Libby, testimony before Joint Committee on Atomic Energy, February 4, 1955:

"The proposed design of a fast breeder reactor for location in a populated area requires that the safety of this type of reactor be determined experimentally. This determination will probably require the construction of a reasonably similar prototype in an isolated area and the testing of this prototype to determine kinetic behavior."

Stuart McLain, Program Coordinator, Argonne National Laboratory, speech delivered August 21, 1956:

"To date the work on fast reactors has not progressed to the point where they can be designed with the safety required for use near populated areas. However, progress is being made."

The CHAIRMAN. Mr. Montgomery, I think I can assure you that the committee has at all times since the beginning, followed the safety operations of the AEC. I do not know about this particular case but the committee has already asked for a report on it. As you say, we want a rundown on all cases.

Mr. MONTGOMERY. Mr. Chairman, that is very encouraging. The AFL–CIO is having a 2-day meeting of representatives from the various unions on atomic hazards tomorrow and Thursday. Now if the committee staff can give us any information you have about the state of enforcement in this thing it would be very, very valuable to this meeting. Do you know how many inspectors they have? Do you know how often a licensee of an isotope is inspected? Do you know whether the plants are being monitored, whether the men are

wearing these badges, whether records are being kept? If you can give us any information on that we would like very much to have it.

The CHAIRMAN. I do not know whether you have ever visited a "hot" plant or not, but I have on several occasions. I am amazed at the safety measures that they take when you go through them. Every workman and everything as far as I have ever been able to observe anyplace is protected in every way possible for safety against radiation hazards.

Mr. MONTGOMERY. I am not trying to be disputatious, Mr. Chairman. I feel reasonably sure that in the atomic energy installations as such a great deal of attention has been given to safety. I have read reports of how they have kept the average exposure down well below what they call the permissible level. But I am talking of the uses in industry, in the several hundred plants in Detroit that have these things in there, like the construction job in Connecticut. What that story says is that there was cobalt-60 hanging on a string and the man wanted a piece of string and he pulled it. He used the string. He liked the looks of this gadget and he put it in his pocket. I do not believe you have been as closely associated with hard gamma rays as that man was for several hours. If you will just see where the doctors leave this man, you will have the same concern that we have.

The CHAIRMAN. We certainly give the doctors advice, and the hospitals, as to how to handle the hazard and we expect them to follow the points of safety.

Mr. MONTGOMERY. If you cannot do anything about it, there will be a great many young workers like Mr. Zawacki, planning to get married, and the doctors tell him, "We cannot tell you whether you dare to have children." That is where Mr. Zawacki is. If we can expect things like that, then we ought to do something about it. I am sure the labor movement is not going to say we cannot do anything about that.

Senator ANDERSON. Have you invited anybody from the AEC to your 2-day conference? Many of these questions should be submitted directly to the AEC. If they are not, then you supply a list of them and we can get them answered by the AEC at a subsequent date. I do suggest it might be very interesting, after you have looked it over a little bit, to ask the AEC to come and deal with these very questions. I think they are very proper.

Mr. MONTGOMERY. Senator, we have what we think are very expert people talking to us. I think we prefer to talk to the AEC after we begin to get our information rather than have them tell us that everything is just fine, as they tell us it is in the reactor field.

Senator ANDERSON. I understood earlier that you were going to have a 2-day conference and then sit down with the groups and discuss these cases.

Mr. MONTGOMERY. That is right.

Senator ANDERSON. If you have some problems on the radiation hazard that have not been answered, I do suggest respectfully it might be well for the AEC to comment. If you do not get any answers, then you might bring it to the chairman of this committee.

The CHAIRMAN. I assure you, Mr. Montgomery, if you submit the questions to AEC and you do not receive the information you desire and you feel that that information is available, you submit them to us and we will see that you do get them.

Mr. MONTGOMERY. Can I be sure that the answers they give us are correct?

The CHAIRMAN. That is another question.

Mr. MONTGOMERY. Thank you very much, Mr. Chairman.

The CHAIRMAN. We have a statement which has been submitted to the committee by the members of the staff of the department of sanitary engineering, School of Public Health, University of North Carolina. Without objection, I will insert it in the record at this point.

(The statement referred to follows:)

STATEMENT PREPARED FOR THE JOINT COMMITTEE ON ATOMIC ENERGY OF THE CONGRESS OF THE UNITED STATES BY THE MEMBERS OF THE STAFF OF THE DEPARTMENT OF SANITARY ENGINEERING, SCHOOL OF PUBLIC HEALTH, UNIVERSITY OF NORTH CAROLINA, CHAPEL HILL, N. C.

As public-health workers and educators we have a concern for the protection of the public from the dangers of overexposure to ionizing radiation. The margin of safety between acceptable dosages of radiation and the exposure of the public will narrow as the atomic-energy industry expands. As this margin narrows, more intensive surveillance will be necessary to protect the public properly.

By law, health departments at all levels are charged with the responsibility for the protection of the population from all forms of health hazards, including radiation. Thus, these official health agencies are required to share responsibilities of this nature with the Atomic Energy Commission. The assumption of these responsibilities implies that persons of proper education in matters of public health and atomic energy are available to conduct such work. An adequate number of such persons is not available at the present time.

Commendation should be given to the Atomic Energy Commission, the Public Health Service, the Department of Defense, and other Federal agencies for their own educational and training activities in the field of atomic energy. They have shared generously with their time and energy to assist in the education and training of other persons; however, these agencies are not primarily educational institutions.

Therefore, it is suggested that the Joint Committee on Atomic Energy of the Congress of the United States take note of the responsibilities of the health agencies and of the limited number of properly educated and trained public-health personnel who can be charged with the technical responsibilities associated with the atomic-energy field. It is further suggested that the Congress financially assist educational institutions to acquire the staff and facilities for the education and training of such personnel. Universities with schools of public health are well suited to conduct these activities because of their ability to bring together faculty resources in physics, chemistry, and biology with those in public health.

Respectfully submitted.

DANIEL A. OKUN,
Head, Department of Sanitary Engineering.
EMIL T. CHANLETT,
Associate Professor of Sanitary Engineering.
MARVIN L. GRANSTROM,
Associate Professor of Sanitary Engineering.
GILBERT L. KELSO,
Associate Professor of Sanitary Science.
CHARLES M. WEISS,
Associate Professor of Sanitary Science.

The CHAIRMAN. The committee is adjourned until tomorrow morning at 10 o'clock. At that time we will meet in the House caucus room.

(Thereupon, at 4:20 p. m., Tuesday, February 26, 1957, the Joint Committeee recessed, to reconvene at 10 a. m., Wednesday, February 27, 1957.)

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

WEDNESDAY, FEBRUARY 27, 1957

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The committee met at 10 a. m., pursuant to recess, in room 219, Old House Office Building, Hon. Carl T. Durham (chairman of the Joint Committee) presiding.

Present: Representatives Durham, Price, Dempsey, Cole, Van Zandt, and Patterson.

Also present: James T. Ramey, executive director; George E. Brown, Jr., David R. Toll, professional members of the staff; and George Norris, Jr., committee counsel.

The CHAIRMAN. The committee will be in order.

This is a continuation of the hearings of yesterday afternoon. At this morning's session, I believe we have Mr. Jerome Luntz, editor of Nucleonics, as our first witness.

STATEMENT OF JEROME D. LUNTZ, EDITOR, NUCLEONICS, McGRAW-HILL PUBLISHING CO., NEW YORK, N. Y.

Mr. LUNTZ. Mr. Chairman, I would first like to thank you for the privilege of appearing before your committee. I take a personal interest in these hearings because, in my testimony in the hearings on the 1954 law, I proposed having such an annual review of the state of the industry. I would like to believe that they have served and are serving a useful function.

My name is Jerome D. Luntz. My training is as an electrical engineer. I am now the editor of Nucleonics, a McGraw-Hill publication serving the worldwide atomic-energy field.

Representative COLE. Before you go any further, Mr. Luntz, I missed your statement when you made reference to the fact that you were the one who made this suggestion that the committee should hold hearings at the beginning of each year. I just wanted to verify that as a fact. I think it is a very worthwhile suggestion that you made. Just how long these public hearings will be feasible only the future can tell. But in this early stage, I think it is a very wholesome suggestion that you made.

Mr. LUNTZ. Thank you very much, Mr. Cole.

Representative COLE. Excuse my interruption.

Mr. LUNTZ. Although I still consider our enterprise a new one, we may actually be one of the oldest private atomic-energy ventures, having started publication in 1947.

Although I am not representing either of these organizations in my appearance here, I am also president of the Nuclear Energy Writers Association and vice president of the American Nuclear Society.

My comments will be primarily addressed to the sixth topic in the committee's suggested list—the international market for reactors and components. In general, my remarks will be tied to the United States atoms-for-peace program.

I firmly believe that we are long overdue on looking realistically at what we expect to get out of atomic energy. There are some who expect the atom to be the cure-all for both the economic and physical ills of the world. There are some who see the atom as the way to make a fortune.

Atomic energy is not yet any of these things and it is still some distance from becoming them.

Because we in the United States are at a crucial point in the growth of our atomic-energy industry and in the development of related policies, it behooves us to do right now what should have been done some time ago—namely, set clear-cut goals on where we want to be going. What do we want to achieve domestically and when? What do we want to achieve internationally and when? An elaboration of the latter question is, What do we mean by world leadership in atomic energy? Obviously, the answers to these questions should provide the guidelines for future activities of both Government and private industry.

I say we're at a crucial point right now for the following reasons. First, and most important, unless we establish a clear-cut international goal pretty quickly, we are liable to lose much of the benefit we have already gained from our atoms for peace program. Second, private industry, which has been doing a valiant job in pressing forward with very costly nuclear power development work, is trying to evaluate what directions it should be moving in. I would like to comment on the latter first.

In 1954, private industry jumped into the nuclear-power picture with both feet after the passage of the 1954 act. It did this not because it foresaw an immediate return on investment—certainly nothing comparable with the speed of return in other fluorishing industries—but rather because it knew that this was something it had to be in for the long pull and that it might well hasten the advent of economically competitive nuclear power by bringing to it an independent, private enterprise approach. Many companies made the decision that they would have to invest sizable sums of money over a period of years before they could expect any real returns.

Bridging the gap in a small way for industry is the contract work it is doing for the Government on military reactors and on civilian reactors. In fact, some companies are doing and will be doing a substantial amount of business in connection with the building of our mammoth nuclear Navy. In addition, our industry has sold a number of research reactors to foreign countries.

But a true and continuing civilian atomic energy equipment industry will be based primarily on the building of civilian power reactors for use in the United States. This is a little way off because, as is well known, nuclear power will not become important here until it can meet the rather stiff competition offered by conventional power sources.

I would like to point out right here that, because of the incentives at play in the domestic atomic-power picture, the size and scope of the governmental and industrial effort are perfect for achieving our domestic objectives. I don't believe there is anyone who says we need to move any faster for our at home purposes.

The real problem, I believe, is in connection with our foreign program. And the reason I described where American industry stands today is that I think industry is in very much of a position where it can be utilized in bolstering our foreign effort.

The atoms for peace effort of the United States dates from December 8, 1953, when the President made his historic address before the United Nations. The implementation of it could only begin, however, after the passage of the 1954 law. In the short intervening time, the United States has done a great deal to assist other nations, primarily in connection with research reactors.

But despite the fact that the United States has done more for other countries on the peaceful uses of atomic energy than any other country—of this I am convinced beyond a shadow of a doubt—strangely enough we are not getting the returns you would normally expect us to get. The British who have done far less than we have on assisting other countries are getting returns as if they had done double what we have done.

By getting returns, I mean getting recognition as a leader in nuclear developments and, as a consequence, having countries turn toward you for assistance. I should emphasize here that my comments are solely directed toward nuclear power rather than atomic energy in general.

I feel that our atoms for peace program can be a failure as far as nuclear power is concerned, unless we take drastic action quickly. We need to do something to capture the imagination of the world. We need to offer other countries very concrete assistance now. And now is the only time that American industry can benefit from whatever foreign market there is.

First I want to buttress my statements about the insufficient returns I feel the United States is getting on its atoms for peace program. Ostensibly, one of the purposes of the program is for the United States to establish itself in the minds of the people of the world as the leader in the development of the peaceful atom. The question of who is the leader is a very difficult one to answer because there is no ready agreement to be found on the criteria to be used for determining leadership. And who we in this country think is the leader is not nearly as important as who people in other countries think is the leader.

To shed light on this, therefore, I arranged for a special survey of world opinion to be conducted by the foreign correspondents of Nucleonics in 11 countries. This was done last October and the results were published last month. Attached to this statement is a copy of the survey.

Briefly, there were two main questions we asked:

1. By whatever standards you use, what country do you consider to be the world leader in the development of peaceful uses of atomic energy?

2. By whatever standards you use, what country do you consider to be the world leader in the development of civilian nuclear power.

Our correspondents interviewed 102 people in 4 categories; atomic energy officials; industrial leaders now in atomic energy or priority customers for power reactors; editors and opinion formers; and the man in the street.

On the first question, the United States was found to be far and away the world leader with a tally of 75 percent as against 13 percent for the United Kingdom, 10 percent for the U. S. S. R., and other countries 2 percent. But on the second question where the emphasis was on leadership in nuclear power, the United States vote dropped to 52 percent of the total as against 40 percent for the United Kingdom and 8 percent for the U. S. S. R. And here the very important industrial leader category actually placed the United Kingdom ahead of the United States by a vote of 55 percent to 40 percent.

I do not offer this survey as the last word on what the world thinks of us. Rather I offer it as a warning sign that all may not be well with our atoms for peace effort. Actually there is already sufficient corroboration for the results of the survey. For example, it has been reported that the Japanese plan to buy their first central station power reactor from the British.

My own feeling is that the United States has the most important reactor program in the world. And it is the one that, in the long run, will have the greatest impact on the programs of other countries of the world. I will amplify this point later.

But our importance in international circles can only be as important as others recognize us to be. We have failed to do an adequate job of selling our accomplishments. And we have failed to excite the imagination of the peoples of the world.

Rather than dwell on the negative, I would prefer to offer some positive suggestions on what I believe needs to be done in our atoms-for-peace effort. Before doing so, I would like first to give my impressions of what the foreign market is and what foreign countries want. These impressions were gained, in part, from several recent trips through Western Europe and attendance at the Geneva atomic energy conference.

I would broadly divide the foreign market into two categories: the ready and the unready. The distinguishing features of these groupings are knowledgeability about atomic energy, in general, and, more important an ability to take advantage of nuclear power. In connection with the latter, it is now quite clear that nuclear power will be significant first in the industrialized areas of the world rather than in the underveloped segments.

In the free world, the ready market consists of the countries in Western Europe and Japan. The unready consists of the other countries in Asia, Africa and Latin America. There is already considerable evidence of the existence of my so-called ready market. The six Western European nations that comprise the Euratom group recently announced their intention to build 15 million kilowatts of nuclear electric capacity by 1967. And Japan has been intensively shopping around for nuclear powerplants in recent months.

One characteristic of the ready market is that it will exist as a potential market for American companies for only a very short time, perhaps several years. After that, there is no question that competitive industries will develop in those countries.

The main need of the unready countries is for information on research reactors and other general information on how to set up atomic energy programs. This need is easy to satisfy and, in fact, is being satisfied, in large part by the United States.

The needs of the ready countries are much more specific. They are already pretty well immersed in atomic energy and have a good feeling for what they need. Basically, their need is for information and nuclear materials, and ultimately, of course, for nuclear facilities.

The Belgians provide a good example of the kind of information being sought by other countries. In November, I had the privilege of participating in a meeting in Brussels sponsored by the Atomic Industrial Forum. The purpose of it was for United States nuclear people to give the Belgians as comprehensive a picture as possible of the latest developments in the United States reactor program. It was exciting to see how eagerly they ate this information up.

An even more concrete example of the third of the Belgians for information about the United States program is given in a report the Belgians have prepared on their plans for nuclear power development. They are in the process of setting up a long-term reactor program. At the moment, they have at least two major activities in mind: starting the building of a 100,000-kilowatt power reactor in the next several years and looking far ahead toward the erection of a fast breeder power reactor. On the latter, they have sent a small team to work with the Detroit Edison group in the United States. As far as the 100,000 kilowatt plant is concerned, they have established a timetable for selecting a reactor type based on the timetable for progress in the United States program. There could be no greater flattery nor greater indication of the usefulness of our program.

In general, the ready countries are seeking guidance on what they should build. This was one of the main purposes of the travels of Euratom's "three wise men" in recent weeks.

These countries are also seeking information of another type—information on the effects of radiation on materials. There is virtually a complete absence of high-flux testing reactors in Western Europe and yet there is a great need for experimental work to be done. I will mention a suggested solution for this problem later.

Another need of the ready countries is for assured supplies of vital nuclear materials, with uranium, of course, being the most important.

All these needs have really developed only in the past year or so. Thus, we have had a bit of a breathing spell in coming up with the means to meet them. But right now we are facing the acid test on whether or not we are really going to put teeth into our atoms-for-peace program.

Thus far foreign countries have not really been falling all over themselves on our doorsteps because, as I have mentioned, there is not universal recognition of the United States as the world leader in the nuclear power field; despite the generosity of our offer of U–235 to other countries, there is a feeling of uncertainty about whether continuity of supply of "235" would be assured; and finally, there is the complexity and redtape of doing business with the United States through classified bilateral agreements.

I am convinced that now is the time—and it is still not too late—for the United States to strike out in the international field with a plan that has boldness of purpose and implementation. We have got to

recognize the importance that other countries attach to their atomic energy development programs. And we have got to recognize the importance to the United States Government and to American industry of our having such a bold program. I firmly believe that we can at the same time help other countries and help ourselves.

I would like to offer the following five suggestions for such a program:

1. Step up our work on technology that would be directly of interest to many foreign countries. One thing that is apparent is the desire of many countries not to be dependent on the United States for supplies of enriched uranium. They would prefer to look at the broader market for natural uranium. The AEC has just started modest programs on the development of natural uranium and plutonium recycle systems. We also have a small amount of work going on on thorium-U–233 systems. I suggest that we give these projects much greater importance. Make them priority projects and perhaps put many more people to work on them.

2. Set up a system for assuring continuity of supply of enriched uranium to other countries. Because we already have so much invested in reactor technology employing enriched fuels, we should make every effort to make the maximum use of it in the international field. But we have got to overcome what may only be a psychological barrier to others coming to us for such fuel. Perhaps what is necessary is only a public statement that would try to knock these barriers down. But perhaps what is necessary is a change in the law to permit longer guaranties of fuel supply. I am not certain of what to recommend here. My main purpose is to call the problem to your attention, and I really believe it is a problem.

3. Build a large test reactor at a place like Brookhaven National Laboratory or perhaps on a university campus or perhaps on an industrial site for exclusive use of foreign countries. There is an urgent need by foreigners for such a reactor in which they could conduct their own experiments as contrasted with merely submitting samples for irradiation. It would have to be set up on a basis under which there would be a minimum of redtape involved. However, before such a project were undertaken by the Government, private groups should be canvassed first to see whether they would have such facilities available for, say, rental by the Government for foreign use.

4. Take bold steps in support of the Euratom and Japanese atomic power programs. I think it would be a major loss if the United States were not involved in some substantial way in both these efforts. One step that might be taken would be to subsidize United States companies so that they could sell power reactors to an organization like Euratom at capital costs competitive with conventional plants in those countries. In addition, there might be a waiver of fuel charges so that operating costs could be brought in line with those of conventional plants. It would be important that the manufacturer and customer be left with incentives to cut costs. Euratom, which has the immediate need for power reactors as contrasted with us here in the United States, might then become a world testing ground for power reactors. Part of our arrangement with them would be for a two-way exchange of information and people so that we would benefit from the effort in the same way the Government now benefits from the power demonstration program

here. In a sense, the Euratom plan would be a foreign demonstration program.

5. Be bold and declassify the entire field of reactor technology except that information on military reactors that is peculiar to the military application of the plant. Our present declassification program is tremendous and I no longer believe secrecy is a deterrent at home. But I do believe classification still imposes restrictions on our ability to work with foreign countries. At the least, it is a psychological barrier. We have gone so very far on declassification. Why not also recognize the great strides being made abroad and go all the way on opening up?

These are my recommendations. I sincerely hope they are of some interest to you, Mr. Chairman; I would like to thank you once again for the privilege of appearing before your committee.

The CHAIRMAN. Mr. Luntz, you have certainly given us a very excellent statement. You have not only pointed out some of our problems, but you have been bold enough to suggest remedial thinking and action. Personally, I think this is one of the finest papers that has ever been brought before this committee.

Mr. LUNTZ. Thank you very much, Mr. Chairman.

The CHAIRMAN. In making the suggestions of trying to do something about this atoms for peace effort, you point out several things we should be doing, and which I certainly appreciate.

Do you think and believe that we should go as far as—I believe you did say here in your statement—as to build a large type reactor here so that they could use it as a kind of tool for research and development by foreign countries?

Mr. LUNTZ. A testing reactor specifically for testing samples that would relate to power-reactor development abroad.

The CHAIRMAN. Do you not feel that, if we are going to make this investment, it would be far better to make it and put it in Europe, where it is convenient, rather than placing it in this country? Why do you say place it in this country?

Mr. LUNTZ. This was my first thought, actually, to suggest placing it in Europe. But then I had the feeling that in the minds of some this might be an indication to them that perhaps we were trying to take over the prerogatives of the International Atomic Energy Agency which conceivably, when it comes into full operation, may well want to do something of this sort.

The CHAIRMAN. Do you feel that they have technical personnel qualified for operating it?

Mr. LUNTZ. Yes; I believe some of the countries do. I think it is primarily from the psychological point of view, once again, that I have had the feeling that it might be more acceptable if it were built here, for the reason of not conflicting with the objectives of regional international bodies and the international agency itself.

The CHAIRMAN. You were speaking with regard to making assurance to the European countries on the fuel elements; namely, that it should be longer, something like perhaps 10 years, instead of 1 or 2 years. That was rather interesting to me. On what do you base such opinion?

Mr. LUNTZ. I have not actually recommended a specific number of years.

The CHAIRMAN. You did recommend a longer period of time.

Mr. LUNTZ. Yes. I believe that the bilateral agreements indicate that a 10-year period would be involved. There is some talk that it might not be out of line—it certainly may not even be illegal if a 20-year period were allowed.

Once again I am dwelling on the psychological barriers that I think exist. In talking to various individuals in western European countries, I find one of the things that come to their minds when they think of getting enriched uranium from the United States is the question, Can they be certain that there will not be a change in policy that will cause their nuclear lifeblood to be cut off? Although I am not a lawyer, I think we have a legal basis for giving long commitments. I think what is actually necessary is a positive statement to the effect that we will assure continuity of supply for the predicted lifetimes of the plants.

The CHAIRMAN. You say we should do something bold, something that would capture the imaginative minds of the European countries at the present time. Of course, I think that was done in the President's speech in December of 1953. We have made that commitment.

Do you think we probably made too bold an approach to this thing in the beginning? If we had done it in a normal fashion by selling it slowly instead of trying to do it so fast, would it have been better? Now we have to overcome that. I agree with the President's speech. I think it was a grand thing to do. I have no objection to that. But the question arises in my mind, if we did not move into the thing too precipitously.

Mr. LUNTZ. No, sir; I do not think the President's statement was too bold a statement. If I may be so humble to say so, I think it was a very well put statement of what we should be doing. I think we have fallen down between then and now. I think we are at the point now where we are being put to the test. Euratom has come forth with this extremely bold plan which they may or may not be able to follow through with. I think if we cannot offer them very positive assistance, perhaps along the lines I suggest, we will then be failing in our atoms-for-peace program.

To go further—this is hindsight, and it is easy to say—I think one of our failures is that we have not recognized up until very recently the interest of foreign countries in such things as natural uranium systems. I think we should have pursued a lot sooner the development of a natural uranium system—a natural uranium-plutonium recycle system. I think this is one of the places where have fallen down. We are trying now to catch up. I would like to see us try very hard to catch up even faster.

The CHAIRMAN. I agree with your statement here. I think this country has more reactor knowledge than any other country in the world. It has been rather difficult for me to understand how the British have created the present situation—that they probably know more about producing power reactors than anybody else in the world. I don't agree with that. How they sold it, I don't know exactly. There has not been any advertising campaign that I have noticed. But they seemed to have gotten across to the people that they have a product better than anybody else's in the world.

Mr. LUNTZ. If I may comment on that, I think the crux of what the British have done is to get a central station power reactor into opera-

tion. Even though it is not a reactor designed primarily for power purposes, but rather is designed primarily for producing a military product, it is looked at by many people in the world as a power reactor. So I think it is primarily because of that, plus the additional fact that the British have announced the unusually bold program of building a sizable number of primarily power nuclear stations over the next decade, which is what has captured the imagination of the people.

I would like to add my own statement, if I may, to what you have just said. The United States reactor program is the most sophiscated one in the world. If you were to talk to British technologists involved in their program, I believe that almost to a man they would readily agree to this fact. The British have put all their eggs in one basket. Many of them realize that for the long pull this particular basket is not the place that is going to be paying off for them. They also recognize the handicaps that they are under in setting up the diversified approach that we have in this country right now. They do not have the manpower or resources to do what we have done, and we are doing.

The CHAIRMAN. Mr. Cole.

Representative COLE. First I want to indicate that I share the chairman's expression of gratitude for the valuable suggestions you have made, Mr. Luntz, among them being that our Government should pursue more vigorously a research and experimentation in the use of natural uranium and thorium. I am not certain, so I am asking you, is not it generally conceded that natural uranium or thorium would be the most expensive type of fuel for nuclear power?

Mr. LUNTZ. One country that has been very much involved in a natural uranium program, Mr. Cole, Canada, argues very strongly for the idea that natural uranium is more favorable from the economic point of view than enriched uranium. Their leading spokesmen speak out on this point very strongly. In fact, in their presentations at Geneva this was exactly their position.

We in this country have been concentrating on enriched uranium, and our reactor people, almost to a man, favor the enriched system.

If I may go on for a moment, I think, regardless of what we here feel is better, enriched uranium or natural uranium, if, in fact, foreign countries that we want to assist are inclined toward natural uranium, for whatever the reason might be—whether it be economics or their own internal politics—then I think that it behooves us to recognize this fact and to make every endeavor possible to assist them along those lines.

Representative COLE. I was thinking that if it should be the consensus of the scientists that natural uranium and thorium would be the most costly nuclear fuel to use, then would it not be a disservice to foreign countries in that approach, rather than to make available to them firm terms and for sufficiently lengthy periods of time the availability of enriched fuels.

I will express it differently. If we should as a matter of policy make firm offers of enriched materials to foreign countries, that being the most economical nuclear fuel in a reactor, would that not be a better course to follow?

Mr. LUNTZ. I would prefer that course, actually, because if these countries find that after a number of years, either through United States developments or their own developments, that natural uranium

turns out to be better fuel, they can, having gotten started with our enriched uranium, later swing over into a natural uranium cycle.

Representative COLE. What do you see to be the objections from the standpoint of our national interest to our adoption of a policy of making available enriched fuels for periods sufficiently long to carry out the life of the reactor?

Mr. LUNTZ. Because of the fact that I think that by one way or another in the next decade enriched materials, whether it be uranium or plutonium, are going to become available abroad, if not through the United States then through other countries, perhaps the British, perhaps through the building of plutonium separation plants—because of this fact, and because of the positive reasons I have stated previously, I can see no objection from the point of view of national policy. I think it is all to the good to do such a thing.

Representative COLE. What conceivable objections do you see for our having that as a policy?

Mr. LUNTZ. Under the proper controls, under the controls that we have our bilateral agreements, and presumably when the International Agency comes into existence further controls are exercised, I see no danger from the point of view of diversion. I just cannot see any objection myself.

Representative COLE. Any such policy of a firm price and time for the fuel would be pursuant to a bilateral agreement, would it not?

Mr. LUNTZ. Yes, it would.

Representative COLE. And if there is any violation of that bilateral agreement by way of diversion of the product to nonpower reactor uses, then of course that firm policy and price would terminate as far as that particular project is concerned.

I see no real serious objection to it. I was groping for a suggestion from you. I feel somewhat assured to have your response that you see none either.

Now, in your suggestion that we might underwrite an American manufacturer who constructs a power reactor abroad by a direct subsidy, in which you relate the degree of subsidy to the capital cost of conventional plants with the atomic plant, would you clarify that a little bit further for me? I am not certain just what you have in mind, and how that would work out.

Mr. LUNTZ. Yes, Mr. Cole. Just taking as an example of a country, for no other reason than that its name comes to my mind, Italy—and I have no reason to believe that the numbers I am going to use are accurate—if the cost per kilowatt of installed capacity of a conventional powerplant in Italy were $300 per kilowatt, and the dollars per kilowatt for a nuclear plant were $350, then my suggestion is that we use the number $50—the differential per kilowatt—as the basis for consideration of a subsidy. I don't think we can possibly come up with any exact numbers. I think we should probably tend to err in the direction of not giving enough subsidy so as to offer incentive to the manufacturer to cut his costs.

Then on the question of operating costs, which may in fact be the principal bottleneck in some of these places, or one of the principal bottlenecks, I believe we should work out a subsidy that would either be a waiver of fuel charges, a waiver of reprocessing costs, but once again a system that would tend to bring the operating costs close to

the conventional plant operating costs. We should have some sort of incentive there.

There has been some talk in recent months about the idea of a subsidy plan that would call for a sliding scale of subsidy of operating costs, where in the first number of years—5 years—you might subsidize to the extent of 5 mills per kilowatt hour, and the next 5 years, 4 mills, but a plan that would not remove the incentive factor from either the manufacturer or the recipient country.

Representative COLE. Who would be the recipient of the subsidy, the foreign government or the American producer?

Mr. LUNTZ. There would be two subsidies involved. On the capital cost it would be the American manufacturer and on the operating costs, the foreign government.

Representative COLE. How could the subsidy be worked so as to preserve the incentives for improved efficiencies?

Mr. LUNTZ. On the operating part.

Representative COLE. I was thinking of the capital cost.

Mr. LUNTZ. Once again to go back to the example that I cited, if the differential between the cost of a conventional plant and the nuclear plant in the country involved were $50 per kilowatt, I would say we would take a number such as $30 or $40 per kilowatt, so that the private company in this country would not be fully subsidized. But based on its projections of what its costs might be, it would have a target to shoot at and would try to reduce its costs.

Representative COLE. I frankly don't share your apprehension that the British are capturing the foreign market on power reactors. I base that on information which was given to the committee a couple of days ago that the American manufacturers have made six firm contracts with foreign governments for power reactors. No other country in the world, Britain included, has made any contract. That is a firm contract I am speaking of. Of course, negotiations are under way.

That would indicate that at least six countries in the world recognize that the American manufacturers in the atomic field offer greater promise than the British.

Mr. LUNTZ. I do not believe I actually said that the British have captured the foreign market.

Representative COLE. In the minds of some people abroad.

Mr. LUNTZ. Yes. I agree with you, Mr. Cole, they have not yet captured this foreign market. The British to my knowledge have actually sold only one reactor, and that is a small research reactor for West Germany. I stand corrected, but I am not aware of any other reactors that they have sold.

I think we are only now getting to the point where, if something like the Euratom plan is realized by the member countries of the Euratom group, a sizable market is coming along. I think what has happened thus far is piddling, actually. It is in this fabulous program of Euratom—I think it is truly fabulous when you compare it with the expected installation of nuclear electric capacity in Britain, the United States, or the Union of Soviet Socialist Republics; it is a fabulous program—I think it is there where the challenge lies. I am not predicting now that the Euratom people are going to turn toward the British. Nor do I say that they are going to turn toward the United States. What I am suggesting is that we take steps that might make it more

likely that the United States Government and United States industry will be in a position where they will be asked by Euratom to offer

Representative COLE. One of your suggestions was that we construct a reactor in some university or appropriate location in this country for use by foreign researchers in testing materials. Is there any reason why a power reactor could not also be used for testing materials? What I am wondering is why your two suggestions of a power reactor abroad could not also be used for testing materials by foreign scientists.

Mr. LUNTZ. I do not think the 2 things can be accomplished efficiently in 1 reactor. If you were to examine the design of our materials-testing reactor in Idaho, and the newst one that will be coming into operation shortly, the engineering test reactor, it can be seen that these designs are very specifically laid out to facilitate the insertion of samples and the testing of samples. I believe that using a reactor where you are trying to get power-reactor experience would cause you to dilute to a very considerable extent the ability you might have to learn from that reactor.

I think, for example, if we had built into the Shippingport reactor the kinds of facilities that are needed to irradiate samples, the costs would go up very considerably and we would get a very false picture on that reactor or any other power reactor.

The CHAIRMAN. The difference is that the power reactors are low flux and the materials testing reactors are high flux.

Mr. LUNTZ. In some cases, if you so desired, you could arrange to get the flux you wanted in a power-reactor system. It is this other conflict that I think would be quite serious. This last point on really understanding what your costs are, I think, might be the most crucial. This is, I think, one of the key purposes of our first power reactors.

Representative COLE. I judge it is your view that any effort to combine the 2 functions in a single operation would jeopardize the success of the effort in either of the 2 fields, or both of them?

Mr. LUNTZ. That is the way I feel, Mr. Cole.

Representative COLE. That is all I have.

The CHAIRMAN. Mr. Price.

Representative PRICE. Mr. Chairman, I am at a disadvantage in that I did not hear Mr. Luntz' statement, due to the fact that Armed Services Committee business prevented me from getting here during his presentation. I am familiar with some of the research Mr. Luntz has done in this field, and I certainly value his opinion. Perhaps the question that I would want to ask right now may have already been asked before I arrived. I have been looking at your survey, Mr. Luntz, which appeared in Nucleonics, January 1957 issue, and particularly the survey on the question: "By whatever standards you use, what country do you consider to be the world leader in the development of civilian nuclear power?"

I note in the chart accompanying that question that class II, which represents industrial leaders in atomic energy or priority customers for power reactors, gives the leadership to Great Britain by a considerable margin. How did you take that poll? What type of poll was it?

Mr. LUNTZ. We had our McGraw-Hill correspondents in the 11 countries that we list in the survey talk to people in each of these 4 categories. These correspondents were working with a prepared ques-

tionnaire. As I mentioned, the 2 questions shown here, including the 1 question you mentioned, were the 2 key questions. The respondents to the survey actually filled out these questionnaires in response to a personal call by our correspondents.

Representative PRICE. In your work in this field, you must direct some amount of research and survey effort both to our program and the reactor program abroad. Have you obtained information from reliable sources as to the British reactor—the Calder Hall reactor?

Mr. LUNTZ. I am familiar with the reactor. Is there something specific about it?

Representative COLE. What is you general opinion of that reactor as a power reactor and the opinion among the people you polled in your surveys?

Mr. LUNTZ. To answer the first part of that, my own opinion of the Calder Hall reactor is this. I think this is readily said by the British. Calder Hall has been designed to produce weapons-grade plutonium. It was optimized for the production of weapons-grade plutonium, with electric power as a byproduct to that.

The first true power reactors that the British are going to build have only just been contracted for. Because of the fact that the Calder Hall reactors were designed for plutonium production, and because of a military time scale and the need to build them on a crash basis, these are not very good power reactors. I say that in comparison with what is evident from the designs that the British industrial groups have turned in on the first power stations, where the expected electrical output from these first industrial reactors will be at least double the ouput of the Calder Hall plants.

So I do not think it is fair to look at Calder Hall as a power reactor. For example, at a symposium that the British held on November 22 and 23 in London, at which time they released for the first time a considerable body of information on Calder Hall, I talked with representatives of a number of foreign countries who were present at that symposium. They came there not to find out about Calder Hall, but where the British expected to go from there. Calder Hall, they recognized, was obsolete. It was obsolete, I think, before it came into operation.

The CHAIRMAN. If the gentleman will yield at that point, some of these experts, Mr. Luntz, feel it is a very good power-producing reactor but a very expensive way of getting plutonium.

Mr. LUNTZ. You can look at it either way, sir.

Representative PRICE. Why would you say that the majority of the people that you polled in the foreign market on power reactors looked upon the British as having any form of leadership in the atomic-power program?

Mr. LUNTZ. I think it is basically this, Mr. Price. I do not want in anything that I have said to detract from the magnificent effort that the British have put into building Calder Hall. I think it has been a magnificent effort. I think it is the first part of a very major and bold program.

I think what has appealed to these industrialists in other countries, and I think what has appealed to other people in the world, is the fact that, despite the basic purpose of Calder Hall, it is a large reactor in operation producing sizable quantities of power. It is in operation. It

is an accomplished fact. This, to people who have a practical turn of mind, is sometimes more important than things that you have in your head or things that you have on paper. So it is on that basis that I think this judgment has been made.

Representative PRICE. That is all I have, Mr. Chairman.

The CHAIRMAN. Mr. Patterson.

Representative PATTERSON. Mr. Luntz, I notice on the last page, section 5, you recommend immediate declassifying of the entire field of reactors with the exception of information pertaining to military reactors. How can you make that kind of a recommendation and still keep the wraps on information that is of a rather secret nature pertaining strictly to the military?

Mr. LUNTZ. My comment, Mr. Patterson, is directed at such things as these. I state explicitly that there should be a declassification of information on everything except information on military reactors that is peculiar to the military nature of the reactors. What I mean by that is, say, on a submarine reactor, if there is some aspect of the plant that relates to fitting the reactor into the submarine hull.

Representative PATTERSON. You mean design?

Mr. LUNTZ. Yes. If there is some aspect of the design of the reactor that relates to making it smaller so that it can fit into the hull, or reducing its weight. For example, I do not believe it is important for the civilian power reactor industry to declassify information on aircraft reactors that relate to the development of very lightweight shielding. Because when you come to building central station power reactors, the weight of this shielding is not important. But as far as an aircraft reactor is concerned, it may be a very vital piece of information. I would not declassify that type of information.

Representative PATTERSON. You say why not also recognize the great strides made abroad and go all the way in opening up. What do you mean by that statement? Opening up what?

Mr. LUNTZ. I mean every aspect of the reactor technology except for the kind of thing I just alluded to.

I think one kind of thing I would mention specifically is nuclear information, information, for example, related to the nuclear design, including fuel-element technology. I don't feel that it is any longer important to retain classified information about our production reactors. I think we are beyond the point where this is important.

Representative PATTERSON. Do you believe that at the present time Russia or any other foreign country working in the field of atomic energy is giving us all the information?

Mr. LUNTZ. No. As a matter of fact, I would say we know very little about Russia. We know a great deal about the British program. Of course, in connection with the British, which is the only other country apart from Russia that has a technology anywhere close to ours, we share declassification guidelines. If we were to do it, the British would presumably have to do it also, or they would have to agree to doing it also.

Representative PATTERSON. On the theory on which you are working, do you think that if we open up the golden gate that Russia in turn would?

Mr. LUNTZ. No; I do not make this a necessary part of my recommendation. In fact, I do not think Russia would do it. I do not think it is any longer important for us to keep this kind of information classified. I would rather take the positive view of it. I think there are advantages in our atoms for peace program in eliminating the need for classified bilateral agreements.

Let me add this statement. I have said here that our present declassification program is tremendous. A new classification guide was announced in the middle of December. It has not yet been implemented. It is in the process of being implemented. Conceivably it could turn out that this new declassification guide would accomplish what I am suggesting here. From the public statements made by AEC officials, it is not yet clear that this would be accomplished.

Representative PATTERSON. I notice in another part of your statement that you said something to this effect. That you believe the United States Government should set up plants wherein reactors would be made for distribution or sale to other countries who are in competition with our private industry in reactors. Would that be on a cost plus program or would that be on a Government operated industry type program?

Mr. LUNTZ. Specifically, what I was suggesting was that the United States Government, as far as capital costs are concerned, subsidize American manufacturers on the differential in cost between the cost of a conventional plant and a nuclear powerplant in the country that might be involved. I am not suggesting by any means that we give these reactors away. I am suggesting that we make a very small subsidy, and the subsidy be to American manufacturers, as far as the capital cost is concerned.

On the question of operating costs, I do suggest a subsidy to the foreign country involved, once again to subsidize the differential.

Representative PATTERSON. You said subsidize industry in the country involved. You mean that we are going to subsidize the XYZ corporation in Japan?

Mr. LUNTZ. One of the things that I specifically have in mind is the Euratom group. So presumably it would be a governmental organization.

Representative PATTERSON. I missed something in your statement along the line. Do I understand it correctly that you recommend that the United States Government subsidize a foreign corporation in the building of reactors?

Mr. LUNTZ. A foreign organization, for part of what would be involved.

Representative PATTERSON. The reactor to be sold where?

Mr. LUNTZ. If Euratom were interested in buying a number of central station power reactors, and they were shopping around for a vendor for these power reactors, if at the site where one of these power reactors were to be built the cost of building an equivalent size conventional plant were to be something like $300 per kilowatt and the cost of a nuclear powerplant were to be $350 per kilowatt, there would be a differential of $50 a kilowatt of installed capacity. My suggestion is that if there were an American company that was interested

and able to supply a reactor of the type that this organization wanted, that the United States Government should subsidize that American company to the extent of not $50 a kilowatt, the total differential, but say something like $30 or $40 a kilowatt. There would still be some incentive to reduce the costs by the American manufacturer.

Here the manufacturer would get the subsidy and not the foreign country.

Then we come to the expensive business of running these plants, including the cost of the initial charge of fuel and the reprocessing of fuel. There I make a similar suggestion, that the United States Government in this case subsidize, say, Euratom, on part of what the differential in operating costs would be between the operating costs for a conventional plant of that size and a nuclear plant. Have I made myself clear?

Representative PATTERSON. Yes. In other words, you would be putting the United States Government right into the atomic-reactor business.

Mr. LUNTZ. In the same sense that right now we are subsidizing research reactors in foreign countries to the tune of $350,000 per research reactor. I see basically no difference between the two.

Representative PATTERSON. That is all, Mr. Chairman.

The CHAIRMAN. Have we not done practically the same thing in opening mines and other things with the program we have had in existence for several years?

Mr. LUNTZ. I do think we already have considerable precedent for this.

The CHAIRMAN. There is only the question of declassification. Have you studied the brief we put out on the international control agency by this committee?

Mr. LUNTZ. I have seen it.

The CHAIRMAN. Under the international agreements, would we not have to practically declassify all information on reactors?

Mr. LUNTZ. I believe we would. I believe we are certainly coming to the point where it is going to be inevitable that we will want to have all of our information out in the open. My only suggestion is that we speed this up a bit.

Representative COLE. Mr. Chairman, I assume that you intended that Mr. Luntz' article in Nucleonics should be in the record?

The CHAIRMAN. Yes. Without objection, it will be placed in the record.

(The article follows:)

[From Nucleonics, January 1957]

WORLD OPINION PLACES UNITED STATES IN NUCLEAR LEAD BY SMALL MARGIN

(EDITOR'S NOTE.—Because the question of whether or not the United States is the world leader in civilian nuclear power development was thrust into the center of the domestic political arena in 1956, Nucleonics conducted this special survey, not to prove any one viewpoint correct or incorrect but rather to gather pertinent data that may be useful in the policy debates that will inevitably arise shorly. Nucleonics correspondents polled 4 categories of people (as shown in the chart) in 11 countries: Australia, Austria, Brazil, France, West Germany, India, Italy,

Japan, Lebanon, Mexico, and Spain. Insufficient responses were obtained in England. The questions asked were aimed primarily at getting two pictures: how people rank the United States, United Kingdom, and Union of Soviet Socialist Republics, and what people think of the United States atoms-for-peace program. Included at the end of the survey report are selected statements from some of the respondents.)

The United States is the recognized world leader in the development of peaceful uses of atomic energy, according to a special Nucleonics poll of atomic energy authorities, leading industrialists in the atomic field, editors and other opinion formers, and men in the street of 11 foreign countries of the free world.

Of the 102 persons questioned by Nucleonics correspondents, 75 percent said the United States led in development of peaceful uses of atomic energy generally. The United Kingdom received 13 percent of the first-place votes, the USSR was the choice of 10 percent, and 2 percent of the votes went to other countries.

But only 52 percent of those questioned thought the United States was the world leader in the development of civilian nuclear power. In answer to this question: "By whatever standards you use, what country do you consider the world leader in the development of civilian nuclear power?" the United States barely received a majority of the votes. The United Kingdom was second with 40 percent and the Soviet Union was a poor third with only 8 percent of the votes.

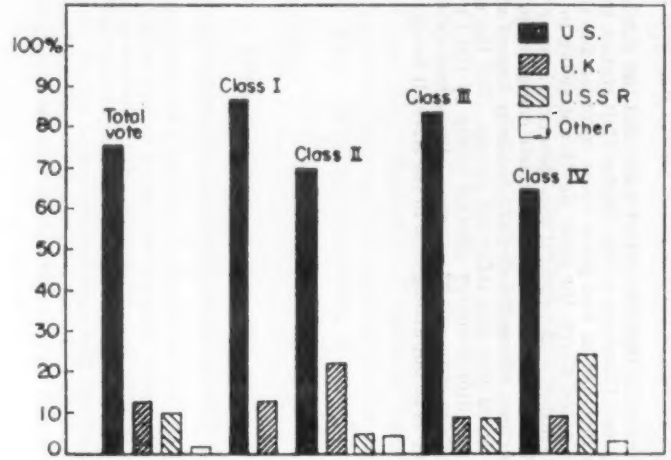
Significantly, the USSR received its highest percentages of votes among editors and opinion formers (class III) and men in the street (class IV).

But of more importance to United States atomic planners is the breakdown of votes on the question of world leadership in civilian nuclear-power development. Of atomic-energy officials (class I), 50 percent thought the United States was the world leader, 45 percent thought the United Kingdom was ahead, and 5 percent chose the Soviet Union. Class II voters (industrial leaders in the atomic energy field) also gave the Soviet only 5 percent of the first-place votes on this question. However, the industrial leaders (who represent potential customers for power reactors) gave 55 percent of the first-place votes to the United Kingdom; only 40 percent of their votes went to the United States.

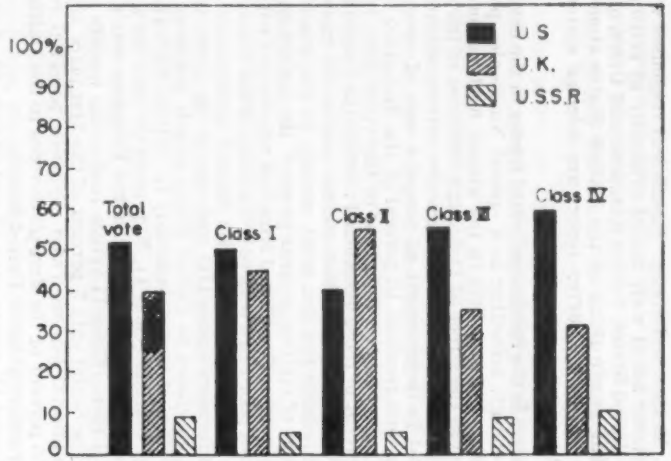
Class III and class IV voters gave 56 and 58 percent of the first-place votes to the United States, 35 and 32 percent to the United Kingdom and 9 and 10 percent to the Soviet Union.

The poll was taken in October of last year, and the publicity associated with the opening by Queen Elizabeth of the Calder Hall station undoubtedly accounts for some of the increase in first-place votes recorded for the United Kingdom. However, as was noted above, the most significant swing in votes for leadership in power (as contrasted with peaceful uses generally) occurred in the class composed of industrial leaders now either in atomic energy or priority customers for atomic-power reactors, where the straight publicity impact should be expected to be less than on technically less informed people. But the contrary is the case. Among class II and atomic-energy officials (class I) the United States shows a percentage point drop of 30 and 37. Among editors and opinion formers the percentage point drop is 28 but among men in the street it is only 6 percentage points.

By whatever standards you use, what country do you consider to be the world leader in the development of the peaceful uses of atomic energy?



By whatever standards you use, what country do you consider to be the world leader in the development of civilian nuclear power?



Class I -- atomic energy officials
Class II -- industrial leaders now in atomic energy or priority customers for power reactors
Class III -- editors and opinion formers
Class IV man in the street

R6

As was indicated, the Soviet Union atomic propaganda had its greatest impact on class III and class IV. It seems clear that the more highly informed groups, if responsive to publicity, are only responsive when there is a degree of solid accomplishment behind the publicity. Several questions were used to shed light on the knowledgeability of the respondents. Asked if they knew of any countries in the world now operating nuclear reactors designed primarily for the purpose of producing useful power, 77 percent said "yes" and 23 percent said "no," some of the 77 percent voting "yes" listing more than one country. Relative to the total listing of countries, the United Kingdom received 31 percent of the mentions, the U. S. S. R. 24 percent, the United States 22 percent, France 11 percent and 10 percent of the mentions were scattered among other countries.

The phrase "desigend primarily for the purpose of producing useful power" was variously interpreted. Both the *Natutilus* and the MTR were listed by name as meeting the criterion, as were Calder Hall (which, although in operation, is designed primarily for plutonium production and generates electricity as a by-product), and Shippingport (which is not yet in operation). Because of the various interpretations given this phrase, it is difficult to draw meaning from responses to the followup questions: "What is the nuclear power being used for, in the countries named?" The belief was indicated in 78 percent of the responses that commercial power was being produced; 20 percent of the responses mentioned popuIsion, heating, or other such uses; and 10 percent of the answers indicated a research or experimental use.

Asked if they could name any countries now building large (50,000 kilowatt electric capacity or greater) central station powerplants, 80 percent said they could. The United Kingdom was listed 65 times, the United States was listed 64 times, the Soviet Union received 50 mentions, France 23, and all others received a total of 10 citations. No significant variation in percentage vote occurred among the four classes.

The survey also contained five questions concerning the United States international "atoms for peace" program. Of the persons queried, 74 percent were aware of the existence of such a program. Asked to specify what the program was, 29 gave no answers, 37 mentioned technical assistance or related matters, 22 specifically listed the supply by the United States of enriched uranium 12 mentioned radioactive isotopes, 11 listed the term "bilateral agreements," 11 mentioned financial assistance, 9 mentioned exhibits, 8 listed research reactors, 6 mentioned the International Agency or international conference; and 4 listed power reactors (some, of course, listing more than 1 item).

Asked "Do you feel the United States should be doing more than it is in its "atoms for peace" program?" 68 percent thought so, 18 percent thought not, and 14 percent gave no answer. Scientists thought the United States was doing "too much already." When asked what more the United States should be doing, 38 respondents gave no answer, 18 indicated that the general peaceful uses should be increased, 18 thought bilaterals should be liberalized 15 wanted, more technical assistance, 13 thought information policies should be liberalized, 7 asked for financial help, 5 wanted help.

In developing power reactors, 4 specifically mentioned the banning of atom-bomb tests, and 11 responses indicated other items.

The final question on the "atoms for peace" program asked for criticism of it as it is now being implemented. Forty responders, or better than one-third of those asked, specifically indicated no criticism. Twenty-six gave no answer, 8 asked for more liberal conditions on enriched fuel, 8 asked for less secrecy, 6 asked for more publicity on the simple level, and 4 asked for less publicity and more action—these being 3 editors and a man in the street.

SOME COMMENTS FROM PERSONS INTERVIEWED

Australia

Atomic-energy official: "United States should open its doors to foreign scientists and reduce some restrictions. More publicity on 'atoms for peace' is required; sincerity of effort should be stressed."

Austria

Man in the street: "Too little information (on United States atoms-for-peace program) reaches the 'uninformed' group of the population." And, "More important than peace program is end of military tests in United States, United Kingdom and U. S. S. R."

Brazil

Atomic-energy official: "If more of our scientists could get into the climate of your 'atoms for peace' program by studying the United States or by listening to United States instructors here in Brazil, we would be able to move ahead much faster, and clear up this political farce." And, "If the United States could spare some top professors or instructors and equipment (for a regional research center in Brazil), it would give Brazilians something to sink their teeth into instead of shouting politics about something they don't know."

France

Newspaper editor: "Any nation that has so much to offer the world as the United States does cannot content itself with the present effort on 'atoms for peace' should be handled as a scientific program, which it is, rather than an advertising campaign, which it is not."

Germany

Atomic-energy official: "The United States should leave irradiated fuel elements in the countries which could make use of them."

India

Newspaper editor: "Too much talk and too little of concrete acts. As atomic knowledge and information is freely available, the United States should take the lead in helping to set up all over the democratic world atomic plants for peaceful uses. The United States should take the lead in developing atomic energy for medicine, transport, industry, etc." (Note: on the basis of "general impressions," this editor ranked the U. S. S. R. first, both in general peaceful uses of atomic energy and in developing civilian power.)

Italy

Industrialist: "It seems to us that Britain has achieved in the field of reactors operated by natural uranium and by graphite a very advanced degree of technical performance, which will allow of immediate industrial results * * * It does not seem to us that any of the types now being studied in the United States approached that level of development, as their plants are little more than experimental ones and in no case such as to be able to produce power in an equally near future at costs approximately competitive with those of power produced by the traditional systems. Looked at from this point of view, Britain should be classed higher than the United States. It is, however, necessary to consider that the Americans have attacked the problem on a much wider front. * * * In our opinion, in a few years almost all the types of reactors now being studied in the United States will be able to attain that level of performance now attained by British technology in the single field of reactors using natural uranium, graphite, and gas. We may indeed presume that some of the reactors the Americans are studying will attain an efficiency of installation and of operation economy that is precluded to the type in which Britain has specialized. * * * It seems to us, therefore, that the delay in American achievement as compared to that of Great Britain is for this reason justified, and we have therefore assigned priority to the United tSates."

Japan

Atomic-energy official: "The United States should provide fuel enriched more than 20 percent. We also want more freedom for chemical processing of spent fuel."

Lebanon

Industrialist: "We need able men abroad. The best men are picked by industry in the United States and leftovers are sent abroad. The United States should choose better experts to send abroad."

Mexico

Industrialist: "The legal code by which foreign nations can obtain enriched atomic fuel should be simplified."

Spain

Atomic-energy official: "The United States should help in developing national techniques for fuel element manufacturing and reprocessing. There are too many restrictions on dissemination of technical knowledge in reactor technology."

Representative COLE. I did want to pursue the foreign subsidies a little. What do you estimate would be the cost per kilowatt of nuclear power over conventional? You used $300 versus $350. Is that reasonably realistic?

Mr. LUNTZ. In talking about real numbers, I guess I can only talk in terms of numbers in this country where this is approximately the installed cost for plants of the order of 100,000 kilowatts. It has been said, and I am not certain of this number, when discussions were held in 1955, as reported in the public press but never stated officially, on the sale of the small power reactor by an American company to Italy that the cost per kilowatt was actually of the order of $400 to $450 a kilowatt. That was something considerably smaller than 100,000 kilowatts. I think $350 is as realistic a number as one could have, although I understand that there have been very major revisions in the cost estimates that some of our own companies that are building power reactors are in the process of making.

Representative COLE. Accepting your estimate of $50 as being reasonably accurate, and assuming that we adopt your suggestion, would it be possible for us to underwrite the Euratom program of 300 million kilowatts at a cost to our Government of around $200 million? We would have thirty 100,000-kilowatt plants. That would represent about half of the amount of investment out of the Federal Treasury for the Gore-Holifield proposal which produces only 4 or 5 or 6 plants. I think it is a very noteworthy and commendable suggestion. I think it has a great deal of merit.

Mr. LUNTZ. Thank you.

The CHAIRMAN. Thank you, Mr. Luntz. I want to join with Congressman Cole in again thanking you for making the suggestion that we include in the 1954 act the provision to hold these hearings. I think it has been very good for the whole country.

Mr. LUNTZ. Thank you very much, Mr. Chairman. Thank you, indeed, for your very kind words.

The CHAIRMAN. The next witness is Mr. McDonald, assistant legislative secretary of the National Farmers Union.

STATEMENT OF ANGUS McDONALD, ASSISTANT LEGISLATIVE SECRETARY, NATIONAL FARMERS UNION

Mr. MCDONALD. Mr. Chairman, my name is Angus McDonald. I am assistant legislative secretary of the National Farmers Union. I am here on behalf of James G. Patton, president of our organization, the National Farmers Union.

If it please the committee, I would like to read the rather brief statement on behalf of Mr. Patton.

The CHAIRMAN. You may proceed.

Mr. MCDONALD. Mr. Chairman and members of the committee, as president of the National Farmers Union, I am here to present certain observations of my organization on the development, growth, and state of atomic-energy industry. I call attention to a statement submitted to this committee on May 29. 1956, in regard to S. 2725 of the 84th Congress, the so-called Gore bill, which would have directed the Atomic Energy Commission to construct six large nuclear powered electric plants at appropriate places throughout the United States.

Although we are aware that the committee is not at present considering, specifically, such legislation, we think it pertinent to point out that our position on the need of such legislation is unchanged; and that, furthermore, there has been no atomic energy development since 1956 to justify a change in our position. Expert witnesses have appeared before this committee pointing up the fact that private industry is still lagging in the atomic-energy field and that the state of existing technology is such that consumer groups, as well as private industry, cannot afford to go all out in the building of large scale experimental plants.

For the benefit of the members of the committee who did not hear or who have not read our testimony on S. 2725, 84th Congress, we wish to reiterate that we feel public policy in regard to atomic-energy development should be related to the policy which was first coherently stated during the administration of President Theodore Roosevelt. This policy, which assumed that the public domain, including interstate navigable waters, belongs to all the people, and therefore benefits should be distributed to the maximum number of citizens, has been consistently adhered to over a period of 50 years. Although there have been many proposals to set aside the so-called preference principle which gives to cooperatives and other nonprofit groups the opportunity to benefit as much as possible from multiple-purpose river developments, which generate and distribute electric power, such proposals have not been approved by the Congress in either Democratic or Republican administrations.

On the contrary, preference laws in regard to the distribution of electric power have been strengthened, not weakened. I call attention to the Flood Control Act of 1944, which not only lays down the principle that the people have first call on power generated at Federal power sites, but that the Secretary of the Interior may build transmission lines in order to bring that power out to load centers where it may be available to rural electric cooperatives and other nonprofit groups. Attention is also called to the Atomic Energy Act of 1954, which sets forth the principle that electric power generated in connection with demonstration or research nuclear electric plants should be made available to cooperatives and municipalities in accordance with the preference rule.

Atomic energy research and development has been financed with public funds on a huge scale. More public money has been utilized for atomic energy purposes, both for weapons and peaceful purposes than the entire annual net income of the Nation's farmers. Farmers, as taxpayers, have contributed to this program and as American citizens are entitled to the benefits of nuclear electric powerplants administered under the rules set forth in the Atomic Energy Act and other statutes. We consider atomic energy to be a part of the public domain and therefore that Federal nuclear electric power should be distributed in the same way that electric power is distributed from Federal hydroelectric projects.

Aside from electric power development, Farmers Union is interested in the research programs made possible by atomic energy development and carried on by State agricultural experiment stations and by the Federal Government. There are presently hundreds of investigations, utilizing atomic isotopes which deal with plants, fertilizers,

and their use, animal genetics, nutrition, physiology and biochemistry and food preservation, being carried on by these agencies. Farmers will ultimately benefit immeasurably from research which utilize radioisotopes as a tool. Radioisotopes are being used to discover better solvents for insecticides and better ways to feed soil, plants, and animals. Radioactive cobalt is used to study the functions and utilization of vitamin B in sheep and chickens. Radioactive calcium and phosphorous are used to study the formation and metabolism of bone. Radioisotope carbon is being used to study milk secretion, physiology of reproduction, the growth of wool, and egg production. Studies are also being carried on to find out what happens to fertilizer when it is put in close proximity to plants. Great strides are being made, we are told, in determining to what degree the fertilizer is assimilated by the plants. Since American farmers are spending considerably more than a billion dollars per year on fertilizer this is of great economic importance. Hundreds of examples could be given, indicating how atomic energy development in the agricultural research field will benefit farmers and American consumers.

Our principal interest here is the development of nuclear electric power industry by private industry, by rural electric cooperatives, and by municipalities. Our information is to the effect that generally, private industry has been holding back nuclear electric power development because it does not wish to be subjected to regulation by the Securities and Exchange Commission and the Federal Power Commission. Attention is called to hearings before this committee, February 16, 1956, at which Walker L. Cisler, president of the Power Reactor Development Co. and Atomic Power Development Associates, Inc., indicated that the inducement of subsidies was not sufficient to prod the firms interested in atomic energy into substantial nuclear power development. He referred to regulation which he considered onerous and to the reluctance of insurance companies to insure large atomic installations. We are not contending that industry is not justified in holding back because of the lack of insurance. We feel that some kind of legislation taking care of this problem should be enacted, although we are not prepared at this time to be specific in this regard.

However, we feel that the insurance situation is one additional reason why the Federal Government should embark on a large scale atomic energy program. As pointed out in our statement of May 29, 1956, the utility industry has estimated that 600 million kilowatts of electric capacity will be needed by 1980. The total amount of atomic power produced by Government, both by Atomic Energy Commission programs and private industry, will amount to less than 1 percent of the total generating capacity by 1960. According to a statement attributed to the Atomic Energy Commission, 5 full scale civilian electric power reactors are being built and 12 are being planned. Upon close analysis, it appears that two of these, the Commonwealth Edison and the Consolidated Edison plants, are still in the paper planning stage; that the Pacific Gas & Electric plant will have a capacity of only 3,000 kilowatts and that the PRDC plant at Monroe, Mich., is of doubtful legality, due to safety hazards. The remaining plant at Shippingport with a capacity of 60,000 kilowatts is the only large scale atomic powerplant under major construction at the present time in the United States.

The others are all on paper or in the proposal stage. The tortuous history of the various proposals that have been made by groups both public and private indicate that the Atomic Energy Commission is not fulfilling its function. Glowing advertisements published in daily newspapers throughout the United States have attempted to convince the American people that private industry, particularly the private electric utilities (whom we understand have had little to do with the great and remarkable atomic energy development), are forging boldly ahead with vast programs designed to keep America, as they allege, in the forefront of atomic energy development.

We have reached the so-called third round stage in the attempts of the Atomic Energy Commission to induce private industry to get going. Although we are not familiar with various procedures laid down by the Atomic Energy Commission, it is our understanding that cooperatives and municipalities, as well as individual private utilities, are precluded from participating under the third round invitation, because no provision is made in AEC's financial invitation for reactor construction financing. Since cooperatives have no independent financial means aside from funds secured under the modest rural electrification program, and since municipalities are legally precluded from financing plants in areas outside their jurisdiction, or in entering into financial combinations, and since individual private electric utilities are too small to undertake the construction of large scale reactors, it is apparent that only combinations, including many utility companies will benefit from the third round invitation. It is significant that utilities interested in building reactors are making plans on a group basis.

This situation obtains in regard to the demonstration program: The Yankee atomic electric plant is financed by a group of 12 utility systems. This program points up the fact that private industry is lagging in atomic energy development. In the 2 years since the demonstration program has been launched there have been 10 proposals and only 1 signed contract. This particular contract has been subjected to severe criticism by the General Accounting Office which contends that the AEC-Yankee atomic energy contract contains serious deficiencies in regard to both financial and power contributions. It is gravely doubtful, according to GAO, as to whether the Government will get its money out of the venture.

An important result of the Atomic Energy Commission policies may be to foster and encourage monopoly. It has stimulated the formation of utility and industrial combinations which may cause monopoly and antitrust problems in the future. Past experience leads us to believe that the growth of monopoly accompanied by a lack of participation of small and competitive groups in any program is a substantial brake on industrial expansion. We respectfully suggest that the committee look into the possibility of probable violation of antimonopoly laws by large utility combinations and call attention to the recent statement of Attorney General Brownell in regard to the danger of monopolistic practices developing in the manufacturing field. Brownell also referred to the public utilities and suggested the "licenses" for joint activities also raised the possibilities for questions under the Public Utility Holding Company Act. Brownell called attention to section 105 (c) of the Atomic Energy Act which requires the Attorney Gen-

eral to advise the Atomic Energy Commission whenever in his opinion it is proposing to issue a commercial license which would tend to create a condition inconsistent with antitrust laws.

Finally, we suggest cognizance be taken by the committee of atomic energy development in other countries and to the importance of United States world leadership in the atomic energy field. Great progress we are told, is being made in Great Britain, and in Russia in regard to production of nuclear power. Russia has been operating an atomic energy plant since 1954 which is said to be more efficient than a similar American powerplant not ready to go into operation until 1960.

According to statistics compiled by the Library of Congress researchers, the Russians are embarked on a vast hydroelectric program. Projects under construction in the Soviet Union will generate 8,217,000 kilowatts. Projects of new generating capacity in the United States totaled 10,477,480 kilowatts. If we are to believe Russians' boast, they will be generating 2 to 2.5 million kilowatt capacity in the next few years. Great Britain has had a plant in production since October of last year and plans a huge nuclear electric program. Significantly, Japanese financiers and scientists were so impressed with the British accomplishments that they decided to utilize British services in building their own nuclear powerplants instead of the services of the United States. Witnesses have pointed out before this committee various plans, including the European Atomic Energy Community's plan for a 3 million kilowatt nuclear program by 1963 and a 15 million kilowatt program by 1967.

We will not labor the controversy as to whether or not the United States is ahead, even with, or behind atomic energy developments in other lands, but we think the evidence presented to this committee during these hearings and past hearings points up the fact that atomic energy development is not going ahead as it should; that the Atomic Energy Commission is not going ahead as it should; that cooperatives and nonprofit groups are being pushed out in the cold and that despite encouragement big industry is lagging behind.

These are matters of great concern, not only to us as members of the Farmers Union, but as American citizens. We think that every citizen has a stake in atomic energy development. Atomic energy will be the energy of the future. Whether or not we keep pace or ahead of atomic energy development may determine our fate as a free nation and as free American citizens. We urge the committee to give every consideration to these broad aspects of the problem. We also urge the committee to give serious consideration to the problem of health and radiation hazards which probably transcend all other developments. We applaud the efforts of other organizations and individuals in regard to safeguarding the health and lives of our citizens from possible explosions from unsafe atomic energy plants built near great population centers.

The CHAIRMAN. Thank you very much, Mr. McDonald. Mr. Cole?

Representative COLE. No questions.

The CHAIRMAN. Mr. Price?

Representative PRICE. No questions.

The CHAIRMAN. Mr. Patterson?

Representative PATTERSON. I have no questions.

The CHAIRMAN. Thank you very much.

Mr. MCDONALD. Thank you.

The CHAIRMAN. The next witness is Adm. W. D. Leggett, Jr., vice president, Engineering Services, Alco Products, Inc.

STATEMENT OF W. D. LEGGETT, JR., VICE PRESIDENT, ENGINEERING SERVICES, ALCO PRODUCTS, INC., SCHENECTADY, N. Y.

Mr. LEGGETT. Mr. Chairman, I accepted your invitation to appear before this committee in the hope that I might contribute something in the way of a better understanding of the problems of small nuclear powerplants. My company does not propose to go into the construction of large central station power units. We do expect to offer nuclear plants in addition to diesel engines in the small or medium power generation field in which we have been a factor for many years. We feel that there will be a continued need for small power generating units for public utilities as there has been in the past both in the United States and in other areas of the world in which the United States has evidenced considerable interest. We expect that eventually there will be an industrial application for small nuclear powerplants to furnish process steam, heat, and incidental electricity.

I believe you are all familiar with the fact that Alco Products, Inc., formerly the American Locomotive Co., is presently engaged in constructing for the Army at Ft. Belvoir, Va., a package power reactor. This powerplant is a prototype for units to be operated in remote areas where fuel supply is a problem The plant is now nearing completion. During its construction we have acquired some experience and have built up a nuclear engineering group. We have also generated a considerable enthusiasm for atomic power and are interested and anxious to assist in its further development insofar as is within our capability.

During the past year I was involved in a small way in the efforts to provide a satisfactory means of insurance for nuclear powerplants. Alco would like to be numbered among those urging the passage of legislation to provide Government assistance in insurance protection. Senate bill S. 4112 reported by Mr. Anderson permits the Commission to establish the amount of financial protection after considering, among other things, the type, size, and location of the facility. While we would prefer a factor which could be computed in advance, the proposed bill is acceptable. We would not like to inject any factor which would delay its passage.

In discussing the insurance situation and on some other occasions, I have been impressed by the fact that in many quarters small powerplants are regarded as justified only as stepping stones to large central stations. We concede that they are very useful for this purpose but contend that they have a continuing place of their own in any power system certainly for many years to come.

In making our decision to stay in the lower range of nuclear powerplant size, we considered a number of figures which I am sure are familiar to the Commission but which have perhaps not been brought up in this particular connection. At the risk of repetition, therefore, I would like to introduce some of them in justification for a continued development of small powerplants as such.

Of the total energy consumption in the United States about 15 percent goes into the generation of electricity which is fed into the power grid. The majority of this power is generated by large central stations, private and public, but some portion still comes from comparatively small municipal plants. Motor vehicles consume in the order of 20 percent; diesel locomotives, about 7 percent; and some 60 percent goes into the heating and industrial applications. This last is a residual figure and is presented here only as an order of magnitude measurement.

Of the 60 percent, about 35 percent is estimated to be utilized for industrial purposes and about 25 percent for home heating. We are concerned at the moment only with the 35 percent. Of this 35 percent it is estimated that about one half could be taken care of by small nuclear powerplants replacing the heating, process and incidental electricity now commonly generated in large industrial establishments throughout the country. This is roughly the equivalent of the energy consumption by the public utilities at present. A survey made for us in 1955 shows some 2,500 plants in the power range under consideration. That 2,500 is for those plants which generate incidental electricity. It does not cover plants which just generate steam for heat.

Nuclear powerplants are at a disadvantage in connection with the large central station today because of their inability to operate at the high pressures and temperatures required for maximum efficiency. This handicap does not exist in most of the industrial plants because the major demands are for steam at low pressures and temperatures. Indications are, therefore, that the nuclear powerplant should become an economic competitor sooner in this area than in the large central station.

In the area of capital cost, however, the nuclear plant is at a disadvantage. The amount of engineering which still must go into each plant is a major burden. The very low rates of production are a disadvantage. In addition to this, there are imposed such items as the vapor containment, special alarm systems, controls and many other factors which add to the cost of a nuclear plant. These items will only be brought under control by building a succession of plants. This kind of evolutionary development has given us the economy and reliability we enjoy in the more complicated gasoline and diesel engine mechanisms we take for granted today.

I am, of course, aware that it would be difficult, if not impossible, to arrange for any governmental assistance in the construction of a powerplant for private industry. I make no such suggestion. I should also like to stress that Alco has had the most cordial relations with the Atomic Energy Commission and that we are very grateful for the assistance they have rendered us on many occasions over and beyond what was called for in connection with our joint efforts on APPR.

There are two ways of reducing the cost of nuclear power. One is to take a new approach, which, if successful, promises to bring about the desired result. Another is to examine existing systems for the possibility of refining, simplifying, and generally decreasing the cost of such systems. I am heartily in accord with what the Commission is doing in searching out and placing into operation new types of plants.

I feel that the development phase is not receiving sufficient emphasis. Thanks to the positions the Navy has seen fit to put me in and substantial appropriations from the Congress, I have had an opportunity to observe or participate in many developments in the field of power generation. From this experience I would reluctantly predict that we have hardly begun to encounter our problems in the field of nuclear power generation. If this should be the case, it would seem prudent that we select the best known, the most thoroughly understood and what appears to be at this point the most conservative method of extracting power from the atom and carry on this development toward making the simplest, most economical plant possible.

Military developments will not, as a rule, accomplish this. I do not want to give the impression that cost is of no concern to the military. It is and it has become more so in recent years. There are, however, other military ends of weight, space, transportability, and so forth, required to meet purely military considerations which frequently must take precedence over economics.

I would, therefore, suggest a modest continuation of the development of the pressurized water plant as a part of the continued effort to obtain the cheapest and most reliable source of nuclear power. I do not think that anyone would argue that we have gone as far as we can go in the development of this plant. It was selected as the first plant and continues to provide a preponderance of the nuclear generating capacity under construction because of its manifest simplicity, ease of control and ruggedness. I think it is in the national interest that we pursue these good qualities to their logical end as early as possible.

The small powerplant, as such, has the virtue of expediting all development work. This, of course, has been recognized in the programs so far adopted. In no case, however, have any of these programs outside of the military programs permitted any firm to go through a second stage of development.

I do not want to give this committee the impression that Alco is wedded completely to pressurized water. We are looking at other types of reactors and anticipate making a proposal on one of these through the power demonstration program as soon as time permits. We chose, however, to enter the nuclear power program through actually constructing a reactor rather than through study contracts. We found that a lot of engineering, development and some research were required in connection with APPR and that our staff has been pretty busy getting this done.

I was in England earlier this month for the announcement of an agreement between Alco and Humphreys & Glasgow, for the marketing of powerplants using reactors of Alco design. We have also extended an agreement we had with Daniel Adamson in England to include the manufacture of equipment. With the lower cost of special equipment and the high cost of fuel prevailing in England and Western Europe, it is certain that economics will dictate a faster conversion to nuclear power than will occur naturally in the United States. Although we have not completed our first estimate under our new agreement as yet, I rather hope that it will show well for nuclear power. No matter what might happen abroad, our first allegiance will continue to be to the Army with whom we have had the most cordial relations in the construction of the APPR. In addition, we could

undertake the design and construction of another reactor and would be very interested in doing so. An extension of development in pressurized water would be of particular interest.

In summary, Alco Products is constructing the package power reactor for the Army at Fort Belvoir.

Alco Products urges that the Congress pass legislation to provide for government assistance in connection with insurance of nuclear powerplants. We have been very interested in this from the standpoint of prospective small reactor builders. Bills presented by Mr. Anderson and Mr. Price (S. 715 and H. R. 888) appear to provide satisfactory protection to small as well as large reactor builders. We urge their early passage.

Alco Products is convinced from its studies that there is a place for small nuclear powerplants in small municipals and later in industrial applications where some 35 percent of the total energy available annually in the United States is consumed. The development of small reactors should, therefore, be carried on as an end in itself rather than as a stepping stone toward large reactors. The knowledge developed in small reactors will, of course, be available for larger plants.

The pressurized water reactor appears ideally suited for small powerplants because of its inherent characteristics of simplicity and stability.

There are two approaches to reducing the cost of nuclear power. One of these is along the line of developing new cycles. The other is through the selection of a promising cycle and going through evolutionary development. The first program is being pursued energetically by the Atomic Energy Commission. Evolutionary development should be stimulated by inclusion of pressurized water system in a power demonstration program directed toward the most economical power generation possible with this best known cycle.

The CHAIRMAN. Thank you very much, Admiral. That is an excellent statement.

I might say that several members of the committee have been out to visit your project at Belvoir.

Mr. LEGGETT. I understood from Colonel Lampert you had been out, and I was very happy to hear it.

The CHAIRMAN. We were very pleased with it.

Representative COLE. It might be interesting for the record if you would take a minute to explain your experience and progress with the package power reactor, how it is working out, and whether you anticipate it will be as efficient as you had hoped, and give some indication of your experience with cost, and so forth.

Mr. LEGGETT. Our major departure in connection with the reactor which we are building for the Army over the reactors which are being built for the Navy is that we are going to a stainless steel technology in our reactor cores, rather than using the zirconium in the Navy reactors. We have been very gratified with the tests which we have conducted in our criticality facility in Schenectady to find that the stainless steel shows up very well, actually better than we had hoped. It was a very good thing that we put in additional control rods, because we are getting more out of the reactor than we had anticipated.

Other than that we have made departures in control rod drives wherein we put these drives on the bottom of the reactor, instead of in

the top, as the Navy programs do. There are, of course, many other mechanical and metallurgical changes of relatively minor nature, as we go through the development.

Progress has been quite gratifying. We have had the contract since 2 years ago December. So we think it is possible to build a reactor of this size in less than 2 years.

The CHAIRMAN. Is the capacity 2,000 kilowatts?

Mr. LEGGETT. Two thousand kilowatts of electricity.

Representative COLE. You expect it to be in operation in the next couple of months?

Mr. LEGGETT. Yes, sir.

Representative COLE. Tell us something about the transportability of the plant.

Mr. LEGGETT. The transportability is based on keeping every unit of the plant to such size and weight that it can be transported in aircraft now available, not the new one they are just unveiling, which limits the weight of any component to 20 tons.

Representative COLE. That is the goal. Have you accomplished the goal?

Mr. LEGGETT. No, sir, we have not fully accomplished the goal, but we know how it can be done. We could have done it in this particular case, Mr. Cole. We did not take the shielding out of the reactor pressure vessel which we could have done, and reassembled it in the field.

Representative COLE. Then you can at this time assert that this package power reactor is transportable in the aircraft we now have available?

Mr. LEGGETT. Yes, sir, it is transportable. It has deficiencies in transportability as in many other respects. In other words, we could do a much better job in making this transportable by packaging it differently. These are the things you learn as you go through a development stage. We have a reactor which is transportable by existing aircraft.

Representative COLE. Whatever improvements experience shows will make the transportability more easily accomplished will be done?

Mr. LEGGETT. That is correct, sir.

Representative COLE. To what extent would the transportability of that plant be impaired by increasing its power? What I am wondering is, with what you now know in the package power field, are you confident that you can produce a plant that will generate 5,000 kilowatts which will also be transportable?

Mr. LEGGETT. Yes, sir. There are limits, of course, to how far you can go and have it air-transportable.

Representative COLE. It is a distance of transportation.

Mr. LEGGETT. The limits are on air transportability.

Representative COLE. But not the distance the airplane flies?

Mr. LEGGETT. No, sir. That would be no problem as to the distance the airplane flies. I would hesitate to guess how much bigger we could make it. I am quite sure we could go up to 10,000 kilowatts on a highly enriched plant and still transport it in existing aircraft.

Representative COLE. That is all I have.

The CHAIRMAN. Mr. Price.

Representative PRICE. Admiral, there has been a legislative suggestion that there should be a study made of the feasibility of a reactor

for a railroad locomotive. Is your company interested in such a project?

Mr. LEGGETT. We have made some preliminary investigations in connection with this. We feel, yes, that it could be done. It does not appeal to us as a practical thing to do at this stage of the nuclear development. In other words, it would be very expensive, and you would have some difficulty of getting the horsepower into a locomotive that you would want to get into it today.

Representative PRICE. Would there be a reasonable economic advantage of an atomic reactor for a locomotive as against the present diesel locomotive?

Mr. LEGGETT. No, sir.

Representative PRICE. There definitely would not be?

Mr. LEGGETT. That is right.

Representative PRICE. In your statement you were referring to an agreement between Alco and Humphreys & Glasgow for the marketing of reactors of Alco design. Would that design be similar to the package reactor?

Mr. LEGGETT. It would be quite similar to the package reactor. It would be a pressurized water reactor. There are many parts of that design which are not classified at all which could be utilized in any reactors that we built. As a matter of actual fact, it would not be a copy of the APPR in any sense of the word, because that is the first goal and anything we do is going to be changed.

Representative PRICE. I do not suppose this agreement is far enough along for you to know what you might expect in the way of receptance of your foreign operations?

Mr. LEGGETT. No, sir. It looks to us as though we are getting fairly close to an economic area in England and in Western Europe. I feel very strongly that if we could carry on this development, one or two steps further in the States, that we would be competitive over there. I think there are going to be areas where we can sell it now. Of course, every one of these things that you build is a step forward in this evolutionary development that I am plugging for this morning.

Representative PRICE. Would this be a stepped-up reactor to produce more kilowatts than you are capable of producing in the Fort Belvoir reactor?

Mr. LEGGETT. Yes, sir. It appears that for most of the commercial developments, particularly in power generation, that the low limit is around 10,000 kilowatts. There are areas, and we do have some interest in plants of the size or about the size of the Fort Belvoir plant, for process steam and heat, plus incidental power generation.

Representative PRICE. You also state that it is your hope that your company could undertake the design and construction of another reactor.

Mr. LEGGETT. Yes, sir.

Representative PRICE. What type of reactor were you thinking of there?

Mr. LEGGETT. We have another design which we really have not explored far enough for me to say today that this is what we want to do. As a matter of fact, I would prefer not to divulge right now what it is we are thinking about. We would very much like to go one more round on this pressurized water type of reactor, because we believe

that there is an awful lot of cost that can be taken out of this thing if we have a chance to work on it again.

Representative PRICE. Would it be something that you might propose under the third-round program of the Atomic Energy Commission?

Mr. LEGGETT. Yes, sir. We would like to propose it under the third round. My feeling is that the Atomic Energy Commission today is not particularly sympathetic toward pressurized water. In other words, they are following a general pattern of trying to get other kinds of reactors in. In particular, the public utilities are interested in reactors of 10,000 kilowatts, perhaps, but which can be blown up to 100,000 or more kilowatts. The pressurized water reactor can be blown up. It is the biggest single thing we have today or in prospect. I personally feel that it begins to lose its advantages when you get in the large sizes.

Representative PRICE. Would it cause you to increase your personnel?

Mr. LEGGETT. We are having to increase our personnel anyway.

Representative PRICE. Are you having an difficulty?

Mr. LEGGETT. Not particularly. It is not easy. So far we have been successful in meeting our 2 or 3 expansions.

Representative PRICE. If you went into a project 3 or 4 times greater than the package power reactor, would you anticipate too much trouble personnelwise?

Mr. LEGGETT. No, sir. We have some designs fairly well along.

Representative PRICE. Where would you get this personnel?

Mr. LEGGETT. Where would we get the people?

Representative PRICE. Yes.

Mr. LEGGETT. We are doing what everybody else is doing. We are recruiting them from colleges. We have a campaign now. Also you find these people around. They get unhappy where they are. I think we have been very fortunate in having a going plant to work on. We have had something specific to work on. This appeals, then, to the majority of engineers more than abstract studies. So we have had perhaps less difficulty.

Representative PRICE. Would you have to make any allowance in time for additional personnel?

Mr. LEGGETT. Yes, sir. We have had them in schools at Oak Ridge. We have had them in the school at Argonne National Laboratory. Now, Rensselaer Polytechnic, right next door to us, is starting a course with our support, so we will continue the training there.

Representative PRICE. You do not feel that the matter of skilled personnel and the peculiar type of personnel you need on this project would be any barrier to you in going into larger projects?

Mr. LEGGETT. No, sir. There is a limit as to what you can undertake in any engineering endeavor today. All engineers are hard to put your hands on. So far we have been successful and we do have a reservoir of engineers right now working on diesel engines or locomotives or pressure vessels of other kinds which can be drawn on for some of the requirements in the nuclear power field. The only people you cannot get from some other department are the nuclear engineers, as such.

Representative PRICE. You would not hesitate to go into the development of larger type reactors—a nuclear power reactor—solely

out of the fear that you would not be able to obtain the personnel that you would need to develop your project?

Mr. LEGGETT. No, sir. We have just talked over another expansion of our nuclear power division up there, and we feel we can make it. There are limits as to how far you can go along this line. We have no conception as to what this foreign business is going to amount to.

Representative PRICE. That is all.

The CHAIRMAN. Are there any other questions?

Representative COLE. Admiral, can you estimate what percentage of the cost of this package reactor is attributed to the transportability of it?

Mr. LEGGETT. I would say, Mr. Cole, that it is a relatively small amount in this particular plant. It should be, as I pointed out just now, more of a factor than we have made it in this one because we have been primarily concerned in getting a plant that will work. This has been our first consideration. If you would like an estimate, I would say perhaps less than 5 percent.

The CHAIRMAN. Admiral, there has been quite a bit of concern here in America about whether or not the American manufacturer is going to be able to get into this European business in a successful way. Were you invited to England to participate in this, or did you go there to look for business yourself?

Mr. LEGGETT. No, sir; the contact was sought with us.

The CHAIRMAN. They actually sought you out.

Mr. LEGGETT. Yes. Humphreys & Glasgow is a construction outfit. In other words, they are architect-engineers, and they do the plant contracting, and they buy all their things from various places. For their part of it they sought us out. The other one, our arrangement with Daniel Adamson, who is a manufacturer of equipment, is simply an extension of an agreement that we have had for 10 years or more, where he makes heat exchangers and pressure vessels to our design.

The CHAIRMAN. You have actually done business before.

Mr. LEGGETT. Yes, sir; very satisfactorily over a period of at least 10 years.

The CHAIRMAN. You feel that those people, in whatever country, are going to have to seek out the know-how to a large degree here in America.

Mr. LEGGETT. That is what they indicated.

The CHAIRMAN. So many people seem to be greatly concerned with whether or not the American manufacturer is going to get any of it at all.

Mr. LEGGETT. We have signed a long-term agreement with these two firms over there.

The CHAIRMAN. Do you know any other company that has been sought out from this country by European manufacturers?

Mr. LEGGETT. No, sir. I know a great many alliances and agreements.

The CHAIRMAN. I am speaking primarily now of nuclear power development.

Mr. LEGGETT. Yes, sir. I know of a great many agreements in the nuclear power development field between companies in this country and England and Western Europe. How they came about, I have no idea.

The CHAIRMAN. I do not expect you to know that.

Thank you very much, Admiral. We are very glad to have you.

Mr. LEGGETT. Thank you.

The CHAIRMAN. We have a statement here this morning from the Carolinas Virginia Nuclear Power Associates.

Without objection, it will be placed in the record.

(The statement referred to follows:)

STATEMENT ON BEHALF OF CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., BY N. A. COCKE, PRESIDENT

Carolinas Virginia Nuclear Power Associates, Inc., is a nonprofit membership corporation organized under the laws of the State of North Carolina. It was organized by, and its members now are, Carolina Power & Light Co., of Raleigh, N. C., Duke Power Co., of Charlotte, N. C., South Carolina Electric & Gas Co., of Columbia, S. C., and Virginia Electric & Power Co., of Richmond, Va. As stated in its charter in general the objectives of this corporation are: "to discover and study economic ways to produce and utilize nuclear material and atomic energy, primarily for the generation of usable energy, and to study, develop, design, fabricate, construct, and operate one or more nuclear power reactors and any or all component parts, as a means to demonstrate the practical and economical use of nuclear energy for the generation of electric energy, together with such industrial and scientific products and byproducts and applications as may seem desirable, all for the purpose of the advancement of scientific knowledge for the public good and national defense."

This corporation has authority under its charter adequate for the accomplishment of these purposes including the specific authority, as stated in its charter, "to design, develop, fabricate and construct, and operate a nuclear power reactor or reactors or to cause that to be done, and to demonstrate that such reactor or reactors may be relied upon to provide an economical source of heat or other power to be used in the generation of electric energy, and also for other industrial, scientific, and commercial purposes."

The formation of this corporation was the culmination of previous interest and work in this field by the member companies which had been going on for a substantial period of time. My own company, the Duke Power Co., had a man on loan to General Electric Co. working at Knolls Atomic Laboratory of that company for a period of a year in 1953 and 1954. In July of 1955 we organized a special development section which devoted its full time to study of generation of electric power from atomic energy. In October of 1955 the four companies, which organized Carolinas Virginia Nuclear Power Associates, Inc., joined together to form a committee to study and interchange information in regard to generation of electric power from atomic energy. Then in October 1956, these four companies organized this new corporation.

We had, of course, followed with interest the undertakings of electric utility companies in other localities for the construction of atomic-powered electric generating stations. Our interest grew, not only out of the fact that this means of generation was a new development in our field of business, but also out of a fuel-cost situation peculiar to the area of North and South Carolina and Virginia. In the area in which our four companies operate we must largely depend upon coal moved by rail transportation. Water transportation is available only along the seacoast and pipeline movement of natural gas has not made it available in significant quantities at a competitive cost. The cost of moving coal by rail into our area equals or exceeds the cost of the coal at the mine, and both have substantially increased in the past 12 months. To the south and west of the areas in which our companies operate natural gas, on the one hand, and coal with low or no transportation cost, on the other hand, are available. We therefore are particularly interested in atomic energy as a competitor of coal and hope by our activities to contribute to an advance in the art which will make atomic energy competitive with coal.

After the organization of our corporation in October of 1956 we proceeded promptly with development of our plans and program. In November our corportation employed Mr. E. C. Fiss as its engineering director. Mr. Fiss was previously employed by my company and is the man whom we loaned to General Electric Co. for the work at Knolls Laboratory. Working with Mr. Fiss is a technical committe composed of one representative from each of the member companies.

On December 12, 1956, we executed a contract with Stone & Webster Engineering Corp. providing for engineering consultation, design, and supervision. We are presently negotiating with General Nuclear Engineering Corp. (W. H. Zinn, president) as nuclear consultant for our corporation.

As you will see from what has been said our plans were already underway at the time Admiral Strausse announced, on December 11, 1956, his new program for development of additional power reactors. When this new program was made public we took it into consideration in the formation of our plans and we hope that our timetable of operations will meet with the objectives outlined by Admiral Strauss. We are presently engaged in conferences with the manufacturers of reactor equipment and have been and will be in conference with the AEC and its staff. We plan that by the end of the summer we will have determined upon the type of reactor we will build and will have selected a site for its construction. So far we are abreast or ahead of the objectives scheduled in our timetable of operations.

The size and cost of the plant which we will build will of course depend upon the recommendations which we receive from our scientists and engineers and the approval of AEC. I can say now, however, that we plan to build a substantial plant and will give consideration to either a plant referred to as a prototype reactor or to a larger plant capable of producing electricity in commercial quantities. We have directed that a site be chosen which will accommodate the larger size plant. Our plant should not duplicate existing or already planned plants and it is our hope and expectation that the plant we build will make a real contribution to the economical production of electricity by this means.

There are two items presently before Congress which concern us and which I would like to mention. The first is the matter of insurance coverage. The insurance companies have agreeed to make available insurance coverage in very substantial amounts and we are glad that they are able to do so. There is, however, always the possibility in this type of operation that a catastrophe could occur which might not be adequately protected against by the coverage offered. We suggest that Congress should give careful consideration to providing some form of catastrophe coverage over and above that made available by the insurance companies.

The second item which I wish to mention is the application of the Holding Company Act. None of the companies now members of Carolinas Virginia Nuclear Power Associates, Inc., are subject to the Holding Company Act. Under the rules of the Securities Exchange Commission none of the member companies will become subject to the Holding Company Act so long as the new corporation merely produces steam which is sold for use in the generation of electricity, but this limitation could be a handicap in our operations. We have had a conference with the Securities Exchange Commission in regard to this question and we feel that the Commission recognizes that there is a problem for companies, not subject to the Holding Company Act, which has not yet been solved. We suggest that Congress should give careful consideration to exempting from the Holding Company Act utility companies holding a part interest in a nuclear power company which not only produces steam but also owns and operates the entire facilities necessary to complete the production of electricity by this means so that the plant might be operated as a power-producing unit in order to determine its efficiency and usefulness. To do this would require the assignment of a load by one of the member companies.

On behalf of myself, and also on behalf of the companies which are members of Carolinas Virginia Nuclear Power Associates, Inc., I wish to express our sincere appreciation for the opportunity to present this statement in regard to our activities. We hope that our plans can go forward to a successful conclusion that will be of benefit to the Nation and industry as well as to ourselves.

The CHAIRMAN. The committee is adjourned until 2 o'clock.

(Thereupon, at 12 noon, a recess was taken until 2 p. m., the same day.)

AFTERNOON SESSION

Representative DEMPSEY. The committee will come to order.

We will hear now Mr. W. C. MacInnes, chairman of the Florida Nuclear Power Group.

STATEMENT OF W. C. MacINNES, PRESIDENT, TAMPA ELECTRIC CO.

Mr. MacINNES. My name is W. C. MacInnes and I am president of Tampa Electric Co., Tampa, Fla. I am also chairman of the Florida Nuclear Power Group which is comprised of three power companies—Florida Power & Light Co., Florida Power Corp., and my own company. The statement that I am making is on behalf of the three companies, and the presidents of the other two companies are also here this afternoon. We very much appreciate the opportunity to appear before this committee to present our views.

The three Florida power companies combined serve a population of 3 million people, which is three-fourths of the State of Florida. Our transmission systems have been interconnected for years. Our total generating capability is 2 million kilowatts and our power demand is doubling every 5 years. By 1962 we expect to need 4 million kilowatts.

The Florida Nuclear Power Group has been working on the development of atomic power for generation of electricity for almost 2 years. We have met with members of the staff of the Atomic Energy Commission, and we have had regular meetings with various manufacturers such as the Babcock & Wilcox Co. and the Allis Chalmers Manufacturing Co., for the purpose of getting information to decide the many questions which must be resolved before a large-scale reactor plant can be started.

Although the cost of construction of powerplants in Florida is among the lowest in the United States, Florida is an area that has no established fuel resources of its own and must import its fuels. Accordingly, along with our very low construction costs, we have relatively high fuel costs. This makes the possibility of obtaining low-cost fuel from uranium of particular interest.

In following up our objective of achieving a low-cost fuel cycle, we have employed the General Nuclear Engineering Corporation of Florida to work with us in this field. In particular, the feasibility of a natural uranium-heavy water moderated reactor has been explored. Although various coolants can be applied to such a reactor, our examination so far has been limited to high-pressure gas.

The results obtained from the work to date indicate that with such a natural uranium reactor, fuel costs can be potentially obtained which are appreciably less than we now have. Although the construction cost of any nuclear plant will exceed that of a conventional plant, we believe that when combined with the low fuel costs, economically interesting power will develop.

In our opinion, the development of the natural uranium-heavy water-gas cooled reactor approach will contribute importantly to the overall strength of reactor technology in this country. The Florida group is now formulating plans to pursue this low-fuel-cost approach to atomic power, including proposals to the AEC regarding the necessary research and development work.

In addition to the developmental work that needs to be done, we must also decide many other problems such as the location of the plant in Florida. For example, we have already completed a study on an electric transmission network analyzer to indicate where additonal capacity should be located in Florida to best serve the needs of our

three systems. A tentative site for the reactor has been selected from this standpoint.

We are anxious to go ahead with our project as fast as possible, and, assuming that successful plans for research and development can be worked out, we expect to reach a point by 1958 where we can ask for bids on manufacture and construction of the plant with a goal of operation in 1962.

Representative DEMPSEY. Mr. Cole, do you have any questions?

Representative COLE. I am curious to know why the construction costs in Florida are lower than in any other part of the country?

Mr. MACINNES. We do not have the problem of preparing for cold weather and that sort of thing. Our plants and some stations are built completely outdoors with practically no building. In my case, the Tampa Electric Co., we use sideboard, transite walls, and weather problems are different than in the northern parts of the country and it makes for cheaper construction.

Representative COLE. Those reasons are all traceable to weather, climate?

Mr. MACINNES. I think so, sir.

Representative COLE. General Nuclear Engineering Corporation of Florida is a very impressive title. Who is in it?

Mr. MACINNES. We are very proud to have those people in Florida. The president of the concern is Dr. Walter Zinn, formerly with the Atomic Energy Commission. He also has some other men in the organization.

Representative COLE. Unquestionably, you have the services of an outstanding reactor expert. You, of course, cannot answer this, but, because of his universality in the reactor business, I am wondering why he would localize his activites to Florida?

Mr. MACINNES. I think there are 2 or 3 reasons for that. In the first place, I think it is the most delightful place in the country there is to live. I believe he feels his health is considerably improved by living in Florida.

Representative COLE. That is understandable. I still fail to appreciate why he would feel it necessary to include the name "Florida" in the title of his corporation.

Mr. MACINNES. I cannot answer that, sir.

Representative COLE. I judge from what you have told us, Mr. MacInnes, that your group is among those which might be included in the third round of invitations?

Mr. MACINNES. We are hoping to be included.

Representative COLE. You were also in the second group which negotiated and was not considered for one reason or another.

Mr. MACINNES. We had not gotten up to the point of negotiation in the second round. We had been talking about it, but we actually did not get to the point of negotiation. We are at that point right now.

Representative COLE. From what you know so far, the natural-uranium approach offers encouraging prospects?

Mr. MACINNES. Particularly from the point of view of the fuel costs. Our oil prices have increased so rapidly in the last few years that this seems encouraging from the point of view of fuel.

Representative COLE. What size plant do you have in mind?

Mr. MacInnes. We are talking of a plant with a gross capability in electric kilowatts of 150,000, which would produce a net of roughly 134,000, 135,000.

Representative Cole. Do you have any figures on estimates of the total cost?

Mr. MacInnes. Not sufficient to put in the record. We do have some estimates, but we do not feel they are sufficiently accurate to put in the record at this time.

Representative Cole. Can you give me an estimate on the capital cost per kilowatt within the range of 50 percent?

Mr. MacInnes. Our outside estimates at the moment are $54 million to $55 million for 134,000 kilowatts of net capacity, or 150,000 gross capacity, whichever you want to use.

Representative Cole. I am sure you can divide that more readily than I can. What does that come out per kilowatt?

Mr. MacInnes. That is something over $330 or $340 a kilowatt, I believe.

Representative Cole. I would say that is very encouraging.

Mr. MacInnes. We think so; yes, sir.

Representative Cole. That is all.

Representative Dempsey. Thank you very much, Mr. MacInnes.

Mr. MacInnes. Thank you very much for the privilege.

Representative Dempsey. Mr. H. C. Kruse, of Pacific Gas & Electric Co., will not be here, so we will hear Mr. W. A. Steiger, of the National Association of Manufacturers.

STATEMENT OF WILLIAM A. STEIGER, VICE CHAIRMAN OF THE COMMITTEE ON PATENTS OF THE NATIONAL ASSOCIATION OF MANUFACTURERS

Mr. Steiger. Mr. Chairman and members of the committee, my name is William A. Steiger. I am vice chairman of the committee on patents of the National Association of Manufacturers, chairman of that committee's subcommittee on atomic energy, and I am speaking today for that association.

Our association has had the privilege of appearing before this committee on prior occasions in an endeavor to obtain a revision of the patent aspects of the Atomic Energy Act of 1954. In our judgment, the patent provisions were not properly drawn in order to achieve what is necessary and desirable for the public interest. Today, 2½ years after the passage of the act, these patent provisions remain the same. We, therefore, appeal to your committee to give this matter serious consideration at this time and that, as a committee, you recommend remedial legislation to the Congress. We sincerely believe that a sound revision of the patent aspects will provide an added stimulant to the investment of private risk capital in this new field. This, we believe, is consistent with the desires and objectives of your committee.

At my last appearance before your committee, 1 year ago, you had under consideration the report of the Panel on the Impact of the Peaceful Uses of Atomic Energy (generally referred to as the McKinney report). This panel concluded that a general review of the patent provisions of the 1954 act be set aside until September 1, 1959 is closer at hand. While the panel points out the great value of the

patent incentive for advancing this art, it proposes that we carry on for another 2½ years with patent laws which are confusing and which are not in the best interests of this country. While the panel's report has met with good acceptance in industry, it is my understanding that the report has been principally criticized in two respects, one of these being its patent recommendations. We, therefore, urge that you do not follow the patent recommendations of this panel to wait until 1959 to do something.

The National Association of Manufacturers believes the availability of the benefits of atomic energy to the public will be advanced by the enactment of legislation at this time eliminating all reference to the patent aspects of the present Atomic Energy Act except those provisions which prohibit the granting of patents in the weapon field or which relate to secrecy or compensation. We see no justification for having one patent law for atomic energy and another for inventions generally. This is similar to a recommendation made in the report of workshop V of the summer institute held last September at Ann Arbor, Mich., under the joint sponsorship of the University of Michigan Law School and the American Bar Association.

Respecting the patent provisions of contracts between the Commission and its private contractors, such provisions can be drafted in accordance with regulations established by the Commission. This is the practice prevailing in the armed services. In other words, establish such provisions by regulation rather than by statute so as to afford the Commission some measure of latitude.

Your committee has before it for consideration Cole bill, H. R. 600. While, as earlier urged, we believe that all patent provisions should be eliminated from the present act, we also believe strongly that the Cole bill should be passed promptly as it corrects some of the existing defects.

The Cole bill amends section 152 of the present act by eliminating those words which automatically vest title in the Commission to all inventions in the atomic-energy field made or conceived under any contract, subcontract, or other relationship with the Commission. While it has been our previous recommendation that section 152 be eliminated in its entirety, it is believed that the revision proposed by the Cole bill will remove the most objectionable portion of this section, the constutionality of which has been questioned. Furthermore, elimination of this portion of section 152 will, we believe, enable the Commission to more effectively negotiate its contracts with private contractors.

We also endorse section 3 of the Cole bill, entitled "Prior art," which adds—

Provided, That such knowledge or use was described in a paper published by the Technical Information Service of the Commission—

to the present section 155. We urge that such change be made to avoid serious confusion as to the validity of patents issuing to inventors.

We endorse, as provided in the Cole bill, the repeal of sections 153 and 154 of the Atomic Energy Act relating to compulsory licensing. The National Association of Manufacturers is opposed in principle to compulsory licensing. It works an especial hardship on the small or specialty manufacturer. In a recent report prepared by Mr. George

E. Frost for the Subcommittee on Patents, Trademarks, and Copyrights of the Senate Committee on the Judiciary, the following statement is included respecting compulsory licensing generally:

> The newcomer or small manufacturer needs more than the mere right to royalties—when and if the invention proves successful. Success with a new product or process entails investment in research, development, and marketing, and a willingness to move forward despite uncertainties and the ever-present risk of failure. In this area a patent subject to compulsory licensing would have little effect in promoting competition, for the possible license royalties would provide slight incentive and in most instances would not serve to justify the effort and risk involved.

RECOMMENDATIONS

The National Association of Manufacturers, therefore, believes the public interest will be served if the patent provisions of the atomic energy law of 1954 be modified as soon as possible. More specifically, we recommend that—

1. All reference to patents be deleted except those which relate to weapons, secrecy, or compensation so that, in the nonweapon field, there will be a uniform patent law applicable to all inventions.

2. As an immediate step we urge prompt passage of the Cole bill, H. R. 600.

Thank you.

Representative DEMPSEY. Mr. Cole, do you have any questions?

Representative COLE. Mr. Steiger, I am pleased to see that you have retained the courage of the convictions you have had for a number of years with respect to the problems of patents in the atomic-energy field. Many of course who have shared those same views have become discouraged at the prospect of doing anything about it.

As you know, when the act was passed in 1954, which includes the patent provisions that are objectionable to some people, assurances were made that this would be a matter of immediate concern to the Joint Committee and hearings directed to this subject would be held by the Joint Committee. As yet that has not occurred. It is a matter of disappointment not only to me but to you and to others.

I am wondering how extensive do you find to be in the industry, atomic-energy industry, this attitude of dissatisfaction with the present patent law?

Mr. STEIGER. Everyone that I have talked to is thoroughly dissatisfied, Mr. Cole, and disappointed that this committee has not taken action before this. We all hope and pray that this committee will not wait until 1959 to do something about it because we are heading into chaos.

As you know, the act was only passed in 1954, so if I made an invention in 1955 I would not get the patent until 1958 or 1959. So we are heading into the problem. It is not what is happening today but what is going to happen. Under the present act if I do get a patent I have no way of knowing if I have a good patent or invalid patent. I think your proposal would correct that tremendously. It would be a great asset.

Another thing that has happened, of course, is that we are certainly benefiting the foreign inventor. The United States inventor is in a poor position with respect to the foreign inventor.

Representative COLE. Before you get into the foreign field let us finish discussing the effect on the domestic field. Do you have any in-

formation which would support your assertion that the principle of compulsory licensing has tended to discourage energetic efforts?

Mr. STEIGER. Yes; we find invariably in our association, which is composed in the main of small manufacturers, that if a small manufacturer invents and develops a new product, something special, he does not want to license that to the big corporations, he wants to keep that for himself, that is his bread and butter. If he is compelled to license to a big corporation he will collect the royalty but the royalty is not of interest to him. That is a small income. He is interested in his business.

Every time compulsory licensing has ever been proposed it has been the small manufacturer that has opposed the passage of compulsory licensing in this country. It will have no impact on the big manufacturer. Compulsory licensing does not involve the big manufacturer. He can take care of himself. The little fellow who invents the new type of windshield wiper or new type of cigarette lighter for the automobile is the fellow who wants to keep the invention to himself and not give it to everybody else for a small royalty.

Representative COLE. Do you agree that retaining the principle of compulsory licensing as this act does is entirely inconsistent with the objective, which appears to be the accepted belief of everybody, of enlarging the field of atomic-energy knowledge and developing it as rapidly and expanding it as greatly as possible, that it is inconsistent with that philosophy?

Mr. STEIGER. It is inconsistent. I think it is inconsistent with the constitutional provision which established patent law.

Representative COLE. It might have been justfiied at the time there were elements of peacetime reactors which were considered by some to be classified, but now that the whole field of atomic reactors is wide open, no classification, it seems to me the grossest kind of inconsistency to persist in this impeding practice of compulsory licensing.

Mr. STEIGER. I agree with you, Mr. Congressman, and I think that we must keep in mind in these big atomic powerplants there are an awful lot of special parts and pieces that are developed by the small manufacturer. His contributions are very valuable.

Representative COLE. And it is through the accumulation, the aggregation of the improvements of bits here and bits there and everywhere that the article be advanced more measurably than the basic principles that are involved on the various types of reactors.

Mr. STEIGER. Yes, sir; I agree 100 percent. I think the committee can find from the records of its prime contractors the tremendous amount of subcontracting that has been done in the field.

Representative COLE. Now moving into the foreign field, will you discuss that?

Mr. STEIGER. Now in the foreign field I want to be fair now to the Atomic Energy Commission and particularly its Patent Branch, because I have no fault to find. I think under the conditions the Patent Branch of the Atomic Energy Commission has done an outstanding job. I want to say first that, as the law stands today, if I make an invention in the atomic-energy field with my own money, I can get permission usually to apply for patents abroad. In a few cases my patent application might be classified. But as matters stand today I can apply for patent protection abroad if it is supported by my own money.

Now, if any Government money is involved, then the foreign-patent rights go down the drain.

In other words, I would make a rough estimate that 90 percent of the inventions made today so far have been under Government contract, where the Government spent the money, financed development. There these inventions all belong to the Commission. The Commission has neither the personnel, nor has it the money to do extensive foreign filing.

Some foreigners are getting patents in this country, but we are building no patent situation abroad. Now when an American manufacturer goes to sell abroad he is faced with those patents. That thing is in its infancy now, but undoubtedly is going to grow very rapidly.

Representative COLE. Is there any way the law can be changed to give protection to American producers against foreign competitions on inventions, ideas, originating in this country?

Mr. STEIGER. I think if your bill were passed and this first statement eliminated from section 152, I think that would go a long way toward solving that problem. Because with that in the bill as is, if I were in the Commission I would not want to do anything that might be construed as contrary to law. As long as the people in the Commission are faced with the statement that any invention made under any kind of relationship with the Commission belongs to the Government, and that means United States patents and all foreign patents, I do not think we will have any change. I do not see how we can have.

Representative COLE. That section 152 places a cloud of ownership over substantially all of the atomic improvements.

Mr. STEIGER. Yes, sir.

Representative COLE. Since they all are either by the Government or under some phase of Government operation or sponsorship, and yet that same Government has failed to protect the interests of the inventor by filing the necessary applications abroad?

Mr. STEIGER. That is right, there are none filed abroad.

Representative COLE. Whereas 152 will eliminate that and the inventor would then be released to pursue his patents with whatever energy he may want.

Mr. STEIGER Yes. We have heretofore proposed that where the Commission did not want to file or could not file, why not let the inventor file. It has the other effect in this country.

If a contractor turns over an invention to the Government the Government does nothing with it, does not apply for a patent, does nothing with it. That happens to many of them. The inventor or contractor would not spend any money because he has no patent protection. So there is no reason for him to spend money.

In other words, there are a lot of ideas in this country going down the drain because the inventor is not allowed to get a patent and the Government does not bother.

Representative COLE. Were you here the other day when this was discussed by Mr. Mitchell in a rather general way? After listening to his explanation of the foreign patent situation, it did not appear to me as troublesome as you have indicated it to be. I had a feeling that the American inventor was pretty well protected.

That is all I have.

Representative DEMPSEY. Mr. Van Zandt.

Representative VAN ZANDT. Mr. Steiger, I notice in your statement you say that the Cole bill does actually not meet all of the requirements as far as eliminating any limitations on patents. Is my understanding correct?

Mr. STEIGER. Yes, sir.

Representative VAN ZANDT. Have you prepared any language that can be offered in the form of amendment?

Mr. STEIGER. No, we have not, Mr. Congressman. We say to take out all reference in the act to patents except with respect to weapons, secrecy, and compensation. That could easily be done. We have tried since the enactment of this act to get some sort of revision, but have made no progress whatever. Consequently, we hope that maybe this committee will take the Cole bill as is and enact that into law, which would certainly be a big step in the right direction.

Representative VAN ZANDT. Did I understand you to say to Mr. Cole that the limitation in the law now applying to patents is very definitely retarding the progress of all types of business in the atomic energy field?

Mr. STEIGER. In this field, yes, sir; with private money.

Representative VAN ZANDT. That is all, Mr. Chairman.

Representative DEMPSEY. I think that is all, Mr. Steiger.

Representative COLE. Mr. Steiger, again I want to compliment you for your persistence and that of your organization.

Mr. STEIGER. Thank you very much.

Representative DEMPSEY. We will next hear Dr. W. L. Davidson, of the National Association of Manufacturers.

STATEMENT OF W. L. DAVIDSON, VICE CHAIRMAN OF THE NUCLEAR ENERGY COMMITTEE, OF THE NATIONAL ASSOCIATION OF MANUFACTURERS

Dr. DAVIDSON. My name is William L. Davidson. I am a vice chairman of the nuclear energy committee of the National Association of Manufacturers, and I am testifying today on behalf of that association.

As I am sure you know, the NAM is a voluntary organization of over 21,000 members, representing a wide cross-section of American industry, businesses both large and small. Approximately 83 percent of the NAM membership consists of businesses with less than 500 employees; according to a generally accepted Government definition, such concerns are considered "small business." Many of these small-business organizations are participating in the peacetime nuclear energy program, but it is our opinion that wider participation by such groups is desirable and possible. One of our purposes in appearing here today is to speak on behalf of expanded activity in this important program.

Our comments today will be very general in nature. We shall not speak in detail about governmental indemnity against reactor hazards or the status of the civilian power reactor program, since we understand these important matters will be considered individually at a later date. Just in passing we might say, however, that the NAM believes the insurance problem is an urgent one which should be solved as quickly as possible. We hope to have an opportunity to express our opinion relative to this problem at a later date.

In the main, we believe that industrial participation in, and development of, the nuclear-energy field, and particularly since passage of the Atomic Energy Act of 1954, has been highly commendable. In the area of generation of electric power from nuclear energy, over $350 million will be spent by private organizations within the next few years. This is no small sum to be spent in an industry which received its "go ahead" signal only a little over 2 years ago.

Furthermore, we are highly in favor of a policy which invites and encourages industry to construct all full-scale facilities for power production when they are ready, able, and willing to do so. This will go far toward preventing an increase in an already overburdened Federal budget. However, in view of the fact that other organizations, which will appear before you, will doubtless discuss this matter in more detail, we shall not go further into the question of electric power from the atom.

We are of the opinion that there are certain steps which, if taken, would encourage business, especially small business, to participate more fully in the new industry. We believe these steps would assist industry in reaching the desired goal of widest possible application of nuclear energy, and, therefore, we should like to outline these suggestions.

Admittedly, the task to develop the industrial potential of the atom is one of considerable magnitude. Therefore, there must be a cooperative effort between industry and Government; neither group can do the whole job alone. This cooperation can best be accomplished through maintenance of an atmosphere of understanding as to the general areas of activity to be undertaken by each.

In our opinion, Government financing of large scale nonmilitary nuclear projects is not the best way to serve the public interest; in such a program, industry would still do the job under Government contract, but without cost cutting incentives that are present under free enterprise.

However, AEC research and development facilities are already available and are being utilized for both governmental and industrial projects to the advantage of the whole Nation. Once the research and development programs have provided promising results, industry will be prepared to carry forward with private funds large-scale construction and operation functions.

Adherence to this policy will not only aid large firms, it will also be of equal, if not greater, relative assistance to small operators whose research and development funds are limited.

We should like to urge strongly, nevertheless, that industry be given continuing assurance that all AEC prices for materials and services routinely available will reflect full costs, based on the best available data.

We recognize that one of the problems facing the nuclear industry at the present time is the matter of determination of actual and real costs in the various phases of the operation. Certainly in the current state of development of the nuclear-energy field, costs are uncertain and doubtless will remain so until more research and development has been undertaken. Furthermore, costing is not an exact science and in this field particularly, costing is highly complicated.

We were gratified to note in the AEC's report to the Joint Committee pursuant to this hearing that the basic policy of the AEC is to charge full costs for materials; we emphasize our wholehearted support of this policy. Serious consequences would result if industries were to base future plans on costs which later were found to be unrealistically low because of hidden subsidies.

In addition to costing problems, we feel that mention should be made of the fact that Government accounting practices are difficult to translate into figures comparable to those reached in normal industrial accounting procedures. Often it is true that businessmen are skeptical of costs reported by the Government because of this fact. We would recommend that the AEC take particular care to include the same factors which industry would have to take into consideration when determining costs for nuclear operations.

We repeat, therefore, that we hope industry will continue to be assured that financial planning, based upon AEC prices, will not be unexpectedly altered owing to unpredictably higher costs resulting from factors over which industry could have no control. Under such a stabilized situation, it is not unreasonable to expect expanded capital investment in the nuclear-energy field, with the eventual result, we are sure, of lowered costs and expanded capacity brought about by the free-enterprise system.

It is our belief that the development of nuclear energy has reached a point, both in the United States and abroad, where the concept that all information is "born classified" should be critically reexamined. We appreciate fully that other people have addressed themselves to this same point but we feel so strongly about it that we believe it is worth repeating.

We feel that nuclear data, engineering drawings, et cetera, vitally useful to the nuclear industry should be considered unclassified right from the time of their origin. We would recommend limitation of classification only to matters clearly pertaining to the weapons program. We urge that such a change in philosophy regarding classification should be taken without delay; we see no reason why the present concept should be continued.

A program of this nature would make the information available to industry far more rapidly than is currently the case. We do not wish to be critical of the Atomic Energy Commission's declassification program, for it is proceeding as rapidly as we can expect under the circumstances. Certainly a large volume of reports has been declassified and a highly desirable and more liberal declassification guide has been adopted by the AEC, with the result that another crash declassification program is currently underway. However, we believe that a change in the basic concept is most desirable and it would save time, funds, and certainly would avoid the necessity for these recurring crash declassification programs.

While on the general subject of information, we should also like to commend the Atomic Energy Commission for undertaking a program of correlation of the vast amount of data which has been made available to date. Such a program of correlation and codification will be even more important if the suggestion in the preceeding paragraphs is put into effect.

At present, a newcomer to the field is faced with a mountain of information which is broken down only into the most general of

categories. The small-business man has neither the manpower nor, in many cases, the available funds to review and analyze the information which can be obtained in this field. Such a small-business man becomes discouraged trying to wade through all of this literature; indeed, he may not even find the specific data he needs. Then even if he reviews a number of reports, he cannot be sure he has found all available ones.

Therefore, in our opinion, a great service is being given to industry, particularly small industry, by the efforts at correlation of the available literature. We further applaud the indication given by the AEC that the preparation of these summary volumes will be discontinued by the Commission if a commercial or academic publishing house indicates willingness to carry forward this work. It is highly encouraging to have a Federal agency indicate its withdrawal from a field that industry can take over; it is to be hoped that such budget cutting trends will be continued.

We should like to suggest, however, that whenever industry does undertake to prepare summary volumes, they contain critical evaluation of the technical data. Such critical reviews would also be of greater assistance to the small-business man; it would be of particular value if this critical evaluation could be kept current, especially if the "born classified" concept is changed.

In conclusion, we wish to reemphasize optimism as regards the expected industrial development of the nuclear-energy field. We believe industrial participation will continue to expand, provided industry has reasonable assurance that it can proceed as rapidly as sound technology will provide, without excessive restraints or other nontechnical roadblocks.

Thank you, sir.

Representative DEMPSEY. Mr. Cole, do you have any questions?

Representative COLE. You say your membership is 21,000?

Dr. DAVIDSON. Yes.

Representative COLE. Out of that there is a large number of small concerns engaged in the atomic program. Can you give us the approximate number of small-business firms?

Dr. DAVIDSON. I cannot give you the specific number of NAM members who are engaged in this program, Mr. Cole. I can report that in connection with the construction of the Nautilus prototype, Westinghouse has stated that they had over 2,000 subcontractors in this program. I can also tell you that there are 1,600 companies who are utilizing radioisotopes in this Nation today under license from the AEC, and in the most recent Nucleonics Buyers Guide, I believe the November 1956 issue, there are listed 1591 suppliers of equipment that can be utilized by the nuclear industry.

Representative COLE. It is safe to say there are several thousand small-business concerns that are interested in the atomic energy program in one fashion or another either by using isotopes or fabricating atomic implements.

Dr. DAVIDSON. I think that is quite safe to say.

Representative DEMPSEY. Thank you very much, Dr. Davidson.

The hearing will adjuorn until 10 o'clock tomorrow morning

(Thereupon, at 2:45 p. m., Wednesday, February 27, 1957, the Joint Committee recessed, to reconvene at 10 a. m., Thursday, February 28, 1957.)

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

THURSDAY, FEBRUARY 28, 1957

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The committee met at 10 a. m., pursuant to recess, in room P–38, the Capitol, Hon. Carl T. Durham (chairman of the Joint Committee) presiding.

Present: Representatives Durham, Holifield, Price, Cole, Van Zandt and Patterson; Senators Pastore, Dworshak and Gore.

Also present: James T. Ramey, executive director, George E. Brown, Jr., David R. Toll, professional members of the staff and George Norris, Jr., committee counsel.

The CHAIRMAN. The committee will come to order.

This is a continuation of the hearings on the state of the atomic energy industry. This is the seventh day of the section 202 hearings, morning and afternoon. This morning we have with us Mr. Menke, president of the Nuclear Development Corporation of America, of White Plains, N. Y.

Mr. Menke, we are glad to have you with us this morning. I believe you have one of our former associates working with you, Mr. Walter Hamilton. Mr. Menke, do you have a statement?

Mr. MENKE. Yes; I have.

The CHAIRMAN. You may proceed.

STATEMENT OF JOHN MENKE, PRESIDENT, NUCLEAR DEVELOPMENT CORPORATION OF AMERICA, WHITE PLAINS, N. Y.

Mr. MENKE. My name is John Menke. I am president of Nuclear Development Corporation of America in White Plains, N. Y. We are a growing company engaged in research and development of nuclear reactors, specializing in design, development and construction of advanced reactor systems and components. I have appeared before you at other times and have greatly appreciated the privilege.

My purpose today is twofold; to describe to you the growth of NDA during the last year as one example of the development, growth and state of the industry, and to discuss the role of Government assistance in the growth pattern of the industry.

During the last year we at NDA have been very fortunate. We have growth in spite of making our own full share of mistakes. I shall touch upon some of the highlights among the 50 separate activities which have engaged us.

One of the activities which may interest you is our work with the Belgian CEAN (Centre d'Etudes pour les Applications de l'Energie Nucleaire) to build Belgian Reactor No. 2, an advanced materials testing reactor, at Mol in Belgium. A good pattern of foreign cooperation is working now. Six Belgians are working with us full time in White Plains and more are expected. We shall take advantage of manufacturing capabilities in Belgium where possible and manufacture in the United States only what needs to be manufactured here.

I think this is a realistic approach to the foreign sales problem.

On August 27 the Commission approved for negotiation our proposal with the Chugach Electric Association for a high temperature, sodium cooled, heavy water moderated reactor fueled with slightly enriched uranium. I think this was the highest highlight of the year. We are very grateful for the opportunity that this sodium deuterium reactor (SDR) represents; it will be one of our major activities for the next five and a half years.

By extending this technology, SDR can be made a natural uranium plant with long burnup, and no reprocessing or waste disposal problems. For these reasons, it is a reactor designed for export to Japan, Western Europe, and similar locations, in recognition of our foreign policy requirements.

This natural uranium SDR will eventually be a competitive system for large scale use in the United States. It is in the meantime a potential dual purpose machine to produce power and plutonium at a combined cost of more immediate interest.

In the summer of 1956 we opened our Pawling Experimental Station—1,200 acres of exclusion area with a critical facility and a hot laboratory. While it is not so important in terms of size, it is one of the very first such private industrial facilities.

We are undertaking further financing now to add to our facilities. We have great faith in this industry and its future in spite of its present limited profitability.

We have not yet achieved some of our important goals. We have not achieved the large scale multiple manufacturing capability—production—which will soon become necessary. Nor have we yet got the balance which significant military work would give to our efforts. Nor have we yet achieved that perfect patience with which most of this will come.

Senator PASTORE. I understand that you just returned from a European tour.

Mr. MENKE. Yes; I have.

Senator PASTORE. How many countries did you visit?

Mr. MENKE. Four; France, Sweden, England, and Belgium.

Senator PASTORE. What is the impression that you gathered from this visit insofar as their progress as against and compared with ours is concerned?

Mr. MENKE. It, of course, varies with the different countries.

Senator PASTORE. Let me pin you down to England.

Mr. MENKE. It is my opinion that England has done a magnificent job of work, especially at Calder Hall, which deserves our admiration and respect. It is not carping nor mean to diminish the respect in which I hold it by saying that it is also a high cost development.

In Sweden, I saw remarkable progress for such a small country.

Senator PASTORE. More specifically, what are they doing in Sweden that is significant?

Mr. MENKE. In Sweden they have concentrated all their efforts on natural uranium heavy water reactors. Those reactors are variously cooled for moderate temperatures and for high temperatures. The work in my opinion is very ingenious and likely of success. The applications will be first in the town of Vesteros, where the problem of direct heating is almost an all year problem, and therefore one of the few places where it would be efficient. The first reactor that will do direct heating will be a heavy-water natural-uranium heavy-water-cooled reactor at moderate temperature.

Senator PASTORE. How far have they gotten along with this reactor? In other words, did you have an opportunity to pretty well investigate and study what they were doing in Sweden?

Mr. MENKE. Yes; they invited me to look at what they were doing. They are, I would say, well along in the beginning design phases and just starting the detailed design phases. They expect to be operating in 1959–60. It will be a modest reactor achievement but useful in Sweden.

In France there was more to see than I could see. I do not mean that they kept it from me in any classification sense. There was just more to absorb than a single visit in a short time could encompass.

In Belgium there is a very grand plan afoot to make sure that Belgium will have a strong part in the EURATOM community.

Senator PASTORE. The reason I say that is that a short while ago it was my privilege to be a member of the United States delegation at the 10th Annual Assembly. This is on everybody's lips. All the representatives of the various countries of the world saw so much hope and prospect in the development of the peaceful atom. You do say that there appears to be quite a bit of activity in this direction in these countries that you visited. I mean it is not just talk.

Mr. MENKE. Let me say this, that I was there during the height of the Suez crisis. The Suez crisis made a difference. Previous to Suez, my own arguments and all our technical arguments were arguments of economics. How much would things cost and whether we would ever compete with conventional fuels. That was utterly changed by Suez. That is now considered an important question, but the second question. The first question: Is enough energy available when you need it without interference?

They have proceeded from that determination of having enough energy when they need it, and where they need it under their control to laying out their plans for the next 10 years. As you know, the three wise men have expected between 1963 and 1967 they will add 15 million kilowatts of nuclear energy. That is an enormous amount. I believe more than they will accomplish.

Senator PASTORE. That, of course, is all talk. They have nothing definite that they have already started outside of organizinig themselves on paper as to how they are going to do this. But they have not undertaken any project as yet.

Mr. MENKE. It is hard to give you the feeling which I have, but the feeling I have is that it is not all talk. There is underway in each country a vigorous effort to make sure that it has a part of this program.

Senator PASTORE. You mean each individual country is doing its share?

Mr. MENKE. More than that, sir. They are competing very hard to be sure that they have a little more than their share when that community is established.

Senator PASTORE. This is the question I would like to ask you: From that impression, would you say that we in this country have accelerated ourselves in enthusiasm, spirit and activity by comparison with what is going on in Europe in the way of putting up and spending more money for research and development? Have you any comment on that?

Mr. MENKE. It is my impression that we have more to do than we have yet done.

Senator PASTORE. I agree with you. Thank you.

Representative COLE. That does not quite answer your question, however.

Senator PASTORE. It does. It is not too specific, but it is a general impression. The reason why I asked Mr. Menke these questions is because it goes to a personal observation of mine. When I was there in 1956 at the United Nations that seemed to be all talk about the peaceful atom. I was wondering if it was just talk, or they are actually doing something about it, and whether they are more enthusiastic about this than they appear to be.

Representative COLE. I think we can all agree with Mr. Menke's conclusion that there remains much to be done on our part. Nobody disputes that. But the Senator's question is whether your impression of the extent of our effort and our interest and the tempo is comparable with that increased effort and interest in Europe.

Mr. MENKE. I think that Europe in the smaller countries is taking what we have done here as a starting point and using it. I think that we have helped them a tremendous amount. We are examining and exploring more paths than they could ever afford to explore. Some of the paths that we are exploring, mostly those that use enriched uranium, are going to have limited utility for them. I think we have not explored as many paths which would help them or countries that do not have enriched uranium as we need to do. I think we will start to explore some more of those paths.

Senator PASTORE. Let me get this down to specifics. When you answered my question that we need to do a lot more, I understood you, the interpretation that I put upon that was the fact that we should accelerate our attitude and our activity in this country a little more in the future than we have in the past. Did I understand you correctly, or do you want to modify that?

Mr. MENKE. No, I will accept your interpretation.

Senator PASTORE. That is what I gathered from your answer to me. In other words, you think we ought to do a great deal more in the field of research and development than we have been doing in the past in order to match this international challenge that confronts the people of the world today in the peaceful uses of atomic energy?

Mr. MENKE. There is just one word I change in what you said, that is the word "match." They are doing less than we have been doing. So if we increase, we will be more than matching. In order to meet the requirement, we have to do more.

Senator PASTORE. To maintain leadership in this field.

Mr. MENKE. Yes, I believe so. The world is moving fast all over. As a matter of fact, my next written sentence assumes something which I believe is now true, although I am not sure you will all agree with me.

It is now generally agreed that Government assistance—and I mean further Government assistance—is necessary at this stage. The Joint Committee, the Atomic Energy Commission, the utility industry and the equipment industry are in agreement. The remaining questions needing definition are: why, what, who, when and how much. You have, I am sure, had the airline mail pay and similar analogies before you many times. The great importance of this Government assistance is that it is determining now the future pattern of the equipment development and manufacturing industry. I shall try to make some very brief general remarks in the anticipation of more detailed discussion in later hearings.

The reason assistance is necessary is to foreward the foreign policy of the United States, to help meet the real need in Western Europe and Japan and elsewhere by development at a pace accelerated over the present economic needs of our domestic industry. It is the Suez crisis that has pointed this up. It is also true that we have come to a better understanding here at home of the high costs and the time required for such developments.

Assistance should be directed toward reactors that will find a use soon in Western Europe and other power-limited areas and eventually in the United States when required. Development costs and the increment over conventional capital and operating costs seem the proper subjects for assistance.

Development cost assistance should flow to equipment developers and manufacturers; incremental capital costs to either the manufacturers or the purchasing utilities; incremental operating costs to the utilities incurring them. Initially, the larger amounts would flow to the equipment industry. Here is just where the pattern of the future equipment industry is determined now by the contracting agency.

Assistance is needed beginning right now, on as fast a schedule as possible, but with real acknowledgment that the pace is sometimes set by technical requirements.

Assistance will be needed, I think, for the next 6 or 8 years, but not after that.

It would be presumptuous of me to indicate how much assistance; that is the job of the Congress. Nevertheless it is a difficult job to administer any limited amount of funds in order to get the chosen work done. A careful balance must be achieved between overconcentration in too few development and manufacturing centers and "spreading it too thin." Both extremes can defeat your objectives of a healthy, rapidly expanding, and truly competitive atomic industry.

I feel it necessary to say again what a great privilege it is to appear before you and to participate to this small extent in our great democratic process.

Thank you.

The CHAIRMAN. Thank you very much, Mr. Menke. I believe you started in business something like 9 or 10 years ago; did you not?

Mr. MENKE. Nine years ago, sir.

The CHAIRMAN. How many employees did you start with?

Mr. MENKE. Two.

The CHAIRMAN. How many have you today?

Mr. MENKE. Three hundred and forty-nine.

The CHAIRMAN. What is the capitalization at the present time?

Mr. MENKE. The capitalization at the present time, including equity and debt, is about a million dollars. It started at $2,000.

The CHAIRMAN. You have done all of that on your own, with no Government assistance; is that correct?

Mr. MENKE. No, I think the privilege of having Government contracts, of which we have had a great many, has been of assistance. That is the kind of assistance we have had. There have been no facilities or no capital.

The CHAIRMAN. But you did go out and compete for contracts.

Mr. MENKE. Yes, sir.

The CHAIRMAN. If I understand the latter part of your statement—in regard to assistance by the Government—you mean direct assistance or assistance through the type you have already received by getting Government contracts?

Mr. MENKE. I mean the latter. I mean assistance by Government contracts to do work. That is all the assistance that we need and require.

The CHAIRMAN. It was not very clear. That is why I asked you that question.

Mr. MENKE. I thank you for amplifying it.

The CHAIRMAN. You believe in doing it in the way you have been doing it.

Mr. MENKE. Yes.

The CHAIRMAN. Government and private enterprise working together.

Mr. MENKE. Yes, sir. I think that a fair allocation of Government contracts to private industry will get the job done. I would like to add the point that those private contracts should be profitable ones.

The CHAIRMAN. I think you are to be congratulated. I think you have done pretty well.

Mr. MENKE. We have been very lucky.

The CHAIRMAN. Mr. Holifield.

Representative HOLIFIELD. Mr. Menke, I want to compliment you on the frankness of your statement. I want to direct your attention to the bottom of your statement on page 2, where you suggest three areas in which an increased assistance could occur. As I understand it, development cost is now possible. Research and development grants or services are now possible under the act under section 31. Also under the first, second, and third rounds of offers of the Atomic Energy Commission. So that part is taken care of by the law at the present time.

Your operating costs, the third factor that you mention, to a certain extent are taken care of, if I understand your meaning correctly, by the furnishing of fuel elements and the processing of spent fuel elements at Government cost.

Mr. MENKE. There are contributions being made by the AEC in those directions, especially the former. I do not know that they have yet offered to do reprocessing without cost.

Representative HOLIFIELD. Not without cost, but at an arbitrary price, which does not necessarily reflect the cost of operation, which

indicates that there is some absorption of cost by the Atomic Energy Commission in that field.

Mr. MENKE. I believe that there is such a move afoot now. It has not yet been done. The previous invitations said reprocessing at cost.

Representative HOLIFIELD. I want to go into your second suggestion there, increment over conventional capital. I would like to have you analyze for me exactly what you mean by that phrase.

Mr. MENKE. Yes. I would like to give you two extremes and a middle position. One extreme is the Government paying only research and development costs for a new reactor. Another extreme is the Government paying research and development costs, and the entire capital cost of putting a reactor in place.

Representative HOLIFIELD. Such as the Shippingport.

Mr. MENKE. Yes. Let me not mislead anyone. Such as the Chugach Electric Association, too.

My recommendation would be that neither extreme, just research and development or research and development and all the capital costs, be your regular policy. I believe your regular policy should be the research and development cost, plus only that present increment of unnaturalness or newness, unknownness, that is in the capital cost. In other words, to be blunt about it, if a utility would have a normal capital cost, for simple numbers, of $200 a kilowatt and it cost $300 to put a reactor there, I would suggest that only $100 of the capital cost be assisted by the Government.

Representative HOLIFIELD. Let us explore that a minute. I will take your example. You are suggesting that the Government step in and pay one-third of the capital cost of a reactor, the ownership of which would reside in the utility that is putting up the two-thirds.

Mr. MENKE. I think I would like to draw your attention, for instance, to the passenger liner *United States* which is partly paid for by the United States Government.

Representative HOLIFIELD. Please answer my question, and then you can give us an example. Did I correctly understand you?

Mr. MENKE. I do not think I care where the ownership resides. The use of the capital is what is important.

Representative HOLIFIELD. You may not care, but as guardians of the public funds it is the duty of the Congress to care where public funds are expended, and who gets the benefit of it. This is a problem which we have to look right square in the face. What you are suggesting in your example is that we subsidize one-third of the cost of the capital investment of the private corporation and the ownership, including the two-thirds they put up and the one-third the government puts up, remains in the private corporation. That is your suggestion, is it not?

Mr. MENKE. Yes, it may be that part of the capital ownership could remain in the United States.

Representative HOLIFIELD. If it does, then that means that all processes, techniques that are discovered by this, would be available to the United States and therefore available to all other people in the United States.

Mr. MENKE. That is my firm belief, yes.

Representative HOLIFIELD. So you would say that if the Government did go in and provide part of the capital cost that the knowledge

gained by the combined effort should be made available to all the people of the United States?

Mr. MENKE. Very much so.

Representative HOLIFIELD. That takes care of that part of it. That takes care of the paragraph on the top of page 3, where you say the incremental capital cost to either the manufacturers or the purchasing utilities would be a grant-in-aid by the United States, but with a provision therein which would retain to the United States Government, and therefore to all parties interested in it, such techniques and processes as were achieved by the joint effort.

Do you think that the manufacturers and purchasing utilities would go for that sort of arrangement?

Mr. MENKE. I speak for only one, and perhaps the smallest and youngest among them, but we think it would be fair.

Representative HOLIFIELD. That is a fair answer. You know that if we did go into such a program that the administrative responsibility for the allocation of funds to specific corporations would reside in the Atomic Energy Commission. Of course, that would be quite a problem.

Mr. MENKE. Yes.

Representative HOLIFIELD. In view of the past allocation of contracts, and I am speaking now from the standpoint of dollar totals, there are certain great corporations—let us say corporations A, B, C, D, and E,—who have been in the atomic energy program from the very start, who have the greatest know-how, who have the greatest capital, who have the greatest organizations in terms of numbers, if not in terms of quality, and would it not be in the natural course of things probably that these great corporations would receive those grants-in-aid before the rest of the alphabet, including the small corporation that you are a member of?

Mr. MENKE. That is the No. 1 problem, sir.

Representative HOLIFIELD. That is right.

Mr. MENKE. That is what I mean by the contracting agency determining the pattern of the future equipment manufacturing industry. It will have to be handled with fairness, with justice, with equal-handedness and with wisdom, and regulatory agencies can approach that ideal.

Representative HOLIFIELD. You realize the difficulty. You realize that if there are 75 corporations that are anxious to get this work and equipped to get it to a certain extent, and there are only 20 contracts to be put out, you understand that 55 would be left in the cold.

Mr. MENKE. Yes, sir.

Representative HOLIFIELD. So from the standpoint of selection on that basis, you would have quite a problem.

Mr. MENKE. Yes.

Representative HOLIFIELD. On the other hand, if the Government would undertake this cost through contract, as it has worked with your company, without any restrictions upon the releasing of information—I am sure there would be some if private corporations put up two-thirds of the capital, because I cannot share your optimism that they would relinquish certain rights and privileges which I think they are entitled to from the standpoint of their own investment in the ordinary conventional sense of business—we would face a very difficult

situation there in saying that these techniques and knowledge go to the body of the industry; would we not?

Mr. MENKE. I believe when a customer of our company pays for or helps to pay for the development of some knowledge, that knowledge is his product. It belongs to him. I cannot take it away from him. You cannot take it away from us. We have it. But it also belongs to him, and he should have it. I must emphasize that is my belief

Representative HOLIFIELD. I think that is a fair position.

Mr. MENKE. I might say that is the way we treat every one of our private clients also. The first problem which you discuss of allocating 10 or 20 contracts among 75 would-be contractors, that is the problem. That is the problem which you gentlemen can help to give ground rules to the contracting and regulatory agency to follow. Those ground rules I expect to be the subject of your acceleration hearings. More needs to be said on that subject. I am willing to talk to it, but I wonder if this is an appropriate occasion.

Senator PASTORE. On the question that was raised by Congressman Holifield, your suggestion to the effect that one-third of the capitalization would be undertaken by the Government at taxpayers' expense—which is understandable, if we consider this international competition that we are talking about—how do you line that up with your expression to the effect that all of the knowledge that is gathered from this investment belongs to the beneficiary of the one-third capital investment, when he has been using one-third of the taxpayers' money? How do you logically rationalize on that point?

Mr. MENKE. I wonder if I have been misunderstood. If there has been a one-third contribution by the United States Government to a reactor that my company has been associated with, as far as I am concerned, the information gained in building that reactor belongs to the person who helped pay for it, including our company and the person who paid for one-third.

Senator PASTORE. In other words, all of the information and all of the patent rights that come out of the particular project would be public property.

Mr. MENKE. All of that particular project would be public property.

I might even amplify. I think if you are going to export reactors, I would recommend that you consider that this one-third also apply to reactors that we help get built in Europe and perhaps that they be first. That is even more difficult.

Senator PASTORE. Why do you lean so heavily on the one-third contribution? If the Federal Government is willing to put up all the cost of research and development, as they do, let us say, in the Yankee Atomic Energy contract, but the remainder is to be the investment of private capital, inasmuch as there are certain benefits that will accrue over a period of time as this research and development progresses, why should not private industry be willing to take that responsibility? Why is that so important?

Why should private industry in this country which one day will be profitable go in with the attitude that we should be whole from the beginning?

Mr. MENKE. That is a good question.

Senator PASTORE. I think it is quite important.

Mr. MENKE. For two reasons: One is a simple one that I can dispense with rapidly. That is that a single reactor is a $20 to $50 million item. Just to use the vernacular; it is a big deal.

Senator PASTORE. Of course.

Mr. MENKE. If you were to use the philosophy that you mentioned, it would only permit companies who had an income from another business to invest in this business to get into it. But a new company, such as NDA, one which is specializing in this business, which is devoting all its life to this business, would be quite simply shut out.

Senator PASTORE. Yes, but you would be building a reactor only because you have a contract with a private industry or with the Government to build a reactor. You are not going to use it for the manufacture of electricity or generation of current. Yours would be a fixed-price arrangement from the very outset; would it not?

Mr. MENKE. Yes.

Senator PASTORE. You would either be building this reactor for some public utility or you would be building it on a contract for the Government. You are a little different from the case we are talking about. We are talking about starting a reactor on a utility site—I think that is what Mr. Holifield had in mind—where the Government puts up the research and development money and all of the other installation is built by the public utility itself, which hopes one day to actually compete with conventional fuels. That property belongs to them. You have already said that it should belong to them. You are not interested in that. I am for letting them keep it because it is their money. I am for letting the Government put up the research and development because we are in this international competition. But to go beyond that, I am afraid that we would be risking the future of the entire program. We would get into the arguments of giveaway, which of course would be a deterrent rather than an encouragement.

Representative HOLIFIELD. When you give a third of the capital cost of a reactor to a private corporation, you are in the element of giveaway. You have immediately given away right there. Unless you get a quid pro quo, you cannot afford to give away the taxpayers' dollars on a discriminatory basis.

Mr. MENKE. But there is a quid pro quo and that is accelerating the industry. That is just what you are here talking about.

Senator PASTORE. Why is that so important?

Representative HOLIFIELD. It is accelerating one part of the industry unless the knowledge is known to all parts of the industry.

Mr. MENKE. I think it should be known by all parts of the industry.

Representative HOLIFIELD. I do, too.

Representative PRICE. Have you any other idea by which the reactor program could be accelerated?

Mr. MENKE. Yes; there is another way.

Representative PRICE. What would that be?

Mr. MENKE. If this suggestion is not the way it goes, the corporations that have a large flow of profits will direct some of those profits to assistance and cutting down a fixed price, and they will then determine, since it is 50 percent tax dollars, how you spend your tax dollars.

Representative PRICE. Is there any other way than that?

Mr. MENKE. I think that is the way that will happen other than this way.

Representative PRICE. What would your opinion be of suggesting something like the proposals contained in the Gore-Holifield bill?

Mr. MENKE. I think that the building of some reactors at sites which are unequivocal is a good idea. I might add besides, government atomic-energy plants as potential sites, sites in Europe which do not get into the public versus private power controversy. I think that is a helpful way of moving the industry rapidly, also.

The CHAIRMAN. Mr. Cole.

Representative COLE. I am curious to know if you are aware of the suggestion which Mr. Luntz has made along the same line that you have suggested this morning with respect to the incremental capital cost, except that he would limit it to assistance to construction of reactors abroad. Are you familiar with that?

Mr. MENKE. No. I learned this morning that Mr. Luntz was here yesterday. I have not seen or discussed the matter with him.

Representative COLE. It struck me as being a very good suggestion. I was hoping that you were familiar with it so that I could have the benefit of your judgment.

Mr. MENKE. I agree with it; because I thing I have made the same suggestion.

Senator PASTORE. Does Congressman Cole agree with it even as a domestic reactor?

Representative COLE. No. I think it should be foreign initially.

Senator PASTORE. I go along with that.

Representative COLE. The basis of the attractiveness to me is that with a given number of public dollars, a greater variety of reactor concepts can be constructed. Therefore, we would reach an earlier date at which the knowledge of the art will be developed.

Mr. MENKE. I think I have said almost the same thing you said. I said assistance should be directed to reactors that will be used in Western Europe and other power-shortage areas.

Senator PASTORE. I think that is sound. Because I think the only justification we have to use the taxpayers' money in the peaceful uses of the atom is because it is an integral part of our foreign policy. If you have removed that aspect, you have no right to use constitutionally the money of the taxpayers to help one industry and not another industry.

Mr. MENKE. There is not any need.

Senator PASTORE. That is right. The whole justification for this is the international aspect. That is the justification for using the taxpayers' money.

Mr. MENKE. The justification for acceleration is an international problem.

Senator PASTORE. If you can confine this to foreign development of reactors, I can see the reason for it. But if you get into this country, you will bet into the realm of giveaway.

Mr. MENKE. Be a little bit careful. There is a safety consideration here. I do not think you want to export a reactor to Europe to forward the national policy of the United States if it could possibly be said you were using them for a testing ground for one you could not build here.

Representative COLE. The only reason they are being used as a testing ground is because of their high power cost.

Mr. MENKE. Yes.

Representative COLE. I think Mr. Luntz' suggestion was a bit generous in that he expected the United States Treasury to bear the entire increment. It would seem to me the more sound policy would be for our Government to match whatever incremental costs the foreign Government would contribute.

Mr. MENKE. That is very likely more statesmanlike.

Representative COLE. To that extent you could spread your American dollars over a greater field.

Mr. MENKE. Yes.

Representative HOLIFIELD. Before we leave this intriguing discuscussion, and I regret I was not here yesterday to hear Mr. Luntz, testimony, let me point out that the building of those reactors by companies A, B, C, D, and E for utilization in a foreign field would still leave unsolved the discriminatory advantage that would be given to them in the domestic market later on by virtue of their experience and assistance which the Government had given to them unless the Government did retain all rights to the techniques and knowledge as you have suggested.

Mr. MENKE. Can I say that even if the Government retained the right to own the knowledge and patents, there would still be an advantage from the practice of doing the job. It is an inevitable problem and must be handled with evenhandedness, fairness and justice. You cannot, and it will be fatal to the industry if you solve that problem by going to 75 companies.

Representative HOLIFIELD. That is right. You cannot do that.

Mr. MENKE. There is no solution to the dilemma which you pose.

Representative HOLIFIELD. So the suggestion boils down to this. That companies A, B, C, D, and E would be given, under the reasoning of furthering our international policy, sharp advantages over the companies in the rest of the alphabet.

Mr. MENKE. I think that is inevitably true. It is true in the airline industry, in the merchant marine industry, in the railroad industry, in any industry where the Government is taking part.

Representative HOLIFIELD. There has been a great deal of complaint from the small airlines who in the last 17 years tried to get certificates to fly certain routes and offered to fly them without Government subsidy. There had been quite a few complaints regarding the subsidy which has been given the big lines and the monopoly position which they have been given in these franchises.

Mr. MENKE. That is just where I think you must draw the line. You must find that balance between spreading it so thin that you do not get the job done, and creating a monopoly. You must have enough competition remaining in the industries which do grow in order that you have true competition in the future unsubsidized period of the industry.

Representative HOLIFIELD. That is all.

The CHAIRMAN. You have mentioned your contract with the Belgian Government.

Mr. MENKE. Yes, sir.

The CHAIRMAN. I do not know whether you want to discuss it or not, but it seems to me it would be a good example right at the point. You are operating under the present policy that we have.

Mr. MENKE. Yes, sir.

The CHAIRMAN. In regard to trying to help this European situation out of its dilemma on power.

Mr. MENKE. Yes.

The CHAIRMAN. At the present time, are you concerned that you might be wiped out by having a capital of a million dollars, in that you have no fixed cost or guaranteed price? That is according to your agreement. I do not know what type of agreement you have. It seems to be the concern of the manufacturers of parts that this cost increases so suddenly, all of a sudden the capital structure might be destroyed.

Mr. MENKE. The specific Belgian contract that we are under now is not for building of a power reactor, but a materials testing reactor. The problem is not squarely met.

The CHAIRMAN. But it still costs several million dollars, I suppose.

Mr. MENKE. Yes. We are building in partnership with the Belgians. We are not building it all alone. Our risk is only a part of the total risk. In this particular contract our costs will almost surely be covered.

Representative PRICE. That is strictly a testing reactor?

Mr. MENKE. Yes. It is strictly a testing reactor, and I do not think it is exactly germane to the present question. I think it is germane to a pattern of working with industrialized countries in this respect, that industrialized countries are, in my belief, not going to buy 100 percent of their requirements from United States industry.

The CHAIRMAN. Is this contract by the Belgian Government a firm fixed-fee contract with the partnership, or is it on a sliding scale?

Mr. MENKE. The contract with the Belgian Government is a cost-type contract. So it is not germane to this problem. It is germane in this sense only, in the sense that it shows you a way in which the Europeans would like to work. I do not think they would like to work by sending all of their dollars over here and having all the manufacturing done over here. I think they want to work in partnership with part of the manufacturing done there so that they can grow their industry also. If that is not done, I do not think we are furthering the foreign policy of the United States.

The CHAIRMAN. I agree with you on that.

Senator DWORSHAK. You state or reported in your statement on the progress which your firm made in the past year, and then emphasized the need for Government assistance. And I to draw the inference that without such Government aid private industry will be lacking in adequate profit motives to do the kind of job you think is essential to take full advantage of the vast research resources that the Government has accumulated?

Mr. MENKE. Yes, I believe that, because of the urgency of using atomic energy in the foreign policy of the United States. Otherwise, the growth will be small and matched to the economic demands in the United States.

Senator DWORSHAK. Would you presume that the Government is making use of military aspects of nuclear power insofar as the commercial utilization is concerned, that without the element of urgency

that private industry would respond as rapidly as reasonable profits can be made?

Mr. MENKE. Yes.

Senator DWORSHAK. You do not think that is a wise policy?

Mr. MENKE. I think if the international requirements require that we help countries with the atomic-energy program, I think that will be too small to meet the foreign requirements.

Senator DWORSHAK. You mean military or commercial?

Mr. MENKE. Commercial.

Senator DWORSHAK. You believe that insofar as military requirements are concerned, we are making progress but in the commercial field not?

Mr. MENKE. It is not easy to comment on the military. In the weapons program we are making first-rate progress.

Senator DWORSHAK. Why do we have to have this urgency in the commercial aspect? Do you not think that development will take place just as rapidly as profits are available, and if they are not, why should we be too much concerned?

Mr. MENKE. The President in his speech before the United Nations asked us to be concerned about foreign atomic-energy requirements, and those are the ones that will not be met if we work on schedule which profit will show in this country.

Senator DWORSHAK. The President can make promises, but it takes a lot of money and appropriations to implement these programs. The more I travel around the country, the more convinced I am that it is entirely futile to accept these far-flung responsibilities to take care of nuclear development or improve the living standards or to take care of moral aspects of nations everywhere. That is a good thing, but the American people may not be committed to that program. That is a political question. It is nice to have your expression of the confidence in the President, but just the mere fact that he wants to provide nuclear assistance everywhere in the world does not necessarily mean that we have assumed that responsibility.

Mr. MENKE. I would make an amateur statement about this. This country has in the last 50 years brought its standard of living, by and large, not altogether evenly, up to a point where our further efforts to increase it would, in my opinion, be largely marginal. I think we have a standard of living which will only to a small extent increase. I believe that our job in the next 20 or 50 years, and our profits, will come from increasing the standard of living in other places. If we do not do that job, I believe we will sow the seeds of a holocaust.

Senator DWORSHAK. I hope you are not accurate in that forecast.

Representative HOLIFIELD. I hope my friend's pessimism as to raising the standard of living of a great section of the people of this country—and I am speaking now of millions of families whose annual income is less than $100 a month—is not widely shared. I have an optimistic hope that there is a great area in our country where new schools and hospitals and houses and earning power is needed right here at home. I am inclined to kind of go along with the gentleman from Idaho in thinking that we have a considerable area of responsibility at home. I am somewhat doubtful about us going overseas and building reactors which will not be economical even on their standards, and leaving these people over there saddled with a reactor which may be more than their conventional costs of kilowatts at the

present time. I doubt if there would be any lasting gratitude on their part if we did that thing.

Mr. MENKE. I do not think we should do that.

Representative HOLIFIELD. I think possibly we have oversold this atoms-for-peace deal just a little bit, and we are going to be a little bit embarrassed about delivery, just as private industry is a little embarrassed about their promises to this committee 2 years ago when they said, if you will pass the Cole-Hickenlooper bill and open the doors, we will do the job. They are not as honest as you were this morning. They will not come before this committee and say that the only way that they can go ahead with this job is to get their hands in the Government till. Some of us were apprehensive enough that we even wrote that into our minority report some 2½ years ago.

Senator DWORSHAK. I might make this observation. Ten years ago I traveled with a group of the Appropriations Committee in the Senate, and we were in Greece—in Athens—we saw huge piles of tractors and a lot of other equipment on the wharves. We saw fishing schooners that this country had provided for Greece. They were not being used then. I think today that improving the living standards in Greece is just as urgent a problem as it was 10 years ago, when we were there. So when we talk about assuming all of these farflung responsibilities, and then you add the nuclear development, I am fearful that we are taking on a very, very huge program.

Mr. MENKE. Greece is on our side of the Iron Curtain.

Senator DWORSHAK. That is right. It should be, should it not?

Mr. MENKE. I think we helped keep it there.

Senator DWORSHAK. Have we improved the standards of living materially over there?

Mr. MENKE. I believe we have, and have caused them to stay with us.

Senator DWORSHAK. Do you know what it is costing us annually? I am not critical of it. You know we have not accomplished the job. Do you know what we are spending annually?

Mr. MENKE. It is a job for the next 50 years.

Senator DWORSHAK. That is all, Mr. Chairman.

The CHAIRMAN. Thank you very much. We are glad to have had you with us this morning.

Mr. MENKE. Thank you.

Mr. CHAIRMAN. Our next witness is a former colleague of ours in the House, Mr. Jerry Voorhis. We are glad to have you with us again.

STATEMENT OF JERRY VOORHIS, EXECUTIVE DIRECTOR, COOPERATIVE LEAGUE OF THE U. S. A.

Mr. VOORHIS. Thank you. I was told I have 15 minutes. It will take me just that long if I go straight through the statement.

The CHAIRMAN. We will give you as much time as you want.

Mr. VOORHIS. I do not care to go through it; if the committee wants to interrupt me, it is quite all right.

The CHAIRMAN. We will let you proceed until you finish.

Mr. VOORHIS. Mr. Chairman and gentlemen of the committee, my name is Jerry Voorhis, and I am executive director of the Cooperative League of the U. S. A.

The Cooperative League is a national federation of consumer, supply, and service cooperatives. Its affiliated member organizations include in their membership approximately 13 million different families who have invested in the shares of cooperative businesses of various kinds through which they obtain farm supplies, insurance, consumer goods, electric power, savings and credit, health services, housing, and other needs. These people are providing the solution to their own economic problems and supplying their own economic needs without relying upon the Government or any other outside agencies. They give real meaning to the term "people's capitalism" for the rank and file of the American people. When a family owns one or more $5 shares in a credit union and has opportunity to attend meetings where decisions are made about the business affairs of that credit union, it is taking responsibility of ownership and it has a part in a real "people's capitalism." When farmers invest their money in a cooperative fertilizer business or a cooperative oil business, they achieve a degree of ownership in one of these great industries, they assume the responsibilities of ownership, and they are able to help guide policies and the destinies of a part of those industries. The same can be said about the rest of the 13 million families to which I have just referred.

I appear before the committee not as an expert on technical aspects of atomic energy. I am here because of two concerns for the future of our country.

The first concern is for our position among the nations in atomic-energy development.

The second concern is for the future pattern of our American economy as atomic-energy development may affect it.

The material progress of mankind has been measured by his command of energy. Advances of civilization have largely been built on progress in harnessing new sources of energy. Nations and peoples have flourished when blessed with abundant and cheap power. They have stagnated when power and energy were expensive and scarce.

So it will be with us. The cheaper and more abundant the basic energy and power which we use to turn the wheels of industry and plow the furrows of agriculture, the stronger and more dynamic our economy will be. It has been reliably estimated that by 1980 the United States will need a 600 million-kilowatt electric-generating capacity—5 times our present capacity. When we consider that farmers' use of electricity from their rural electric cooperatives has been doubling every 4 years, this estimate is not hard to accept.

If this estimate is anywhere nearly correct, we are going to have to use every resource we possess. And certainly major emphasis should be upon the one resource which appears to be inexhaustible—namely, atomic energy. We are also going to have to guard in every way against increases in the cost of electricity. For, if it becomes more costly, we will be almost as badly off as if we suffer short supply.

Power company advertisements and Atomic Energy Commission oratory to the contrary notwithstanding, the plain facts seem to clearly show that our country is lagging seriously behind other nations in atomic-power development. Whereas Russia has announced by 1960 she expects to have over 2 million kilowatts of atomic power capacity completed, and Great Britain expects to reach 4 million by 1965, a generous estimate for the United States by the latter year, even if

we include projects in the negotiation stage, is only about 1,100,000 kilowatts. Of course, one cannot foresee the future. But one can foresee the difference between progress likely to be made by nations proceeding with an eye only to progress on the one hand, and progress likely to be made by a nation proposing to wait until the very industry that has consistently blocked adequate development of power capacity finds it profitable to itself to take the admittedly great risks of atomic power development.

We have to be both rational and realistic. Our American economic system is a lot bigger than the private utility companies. There are always some difficult, costly, and yet absolutely necessary steps that must be taken in the development of any new resource which so deeply affect the general public interest that they should be logically taken by public bodies and under public responsibility. When they are, the whole of our economy and all our business and, above all, all our people benefit. Atomic energy is a case in point.

We did not wait for the private utility industry to find the way to release atomic energy. We found that way at public expense and by an intense national effort. The American people have an investment of over $15 billion in this, probably the greatest public resource known in history. Both from the standpoint of our country's relative position among the nations of the world and from the standpoint of potential benefits to our own economy, the people are entitled to a better record of progress in development of practical uses of this great new resource than they have had up to date.

We do not want Russia to take the lead over us in overwhelmingly the most important economic development of our time. If she does so, she will come pretty close to winning the cold war. We do not want that to happen, even if we have to bypass the private electric utilities to forge ahead—even if Congress has to require a change of policy on the part of the Atomic Energy Commission.

Let us be realistic enough to recognize that the position of the United States in atomic power development thus far is due entirely to Government research, development, construction, and finance. Without Government initiation and without almost complete Government financing at Shippingport, Pa., there would be no sizable power reactor under construction in the United States today. Without the Government's submarine reactor program it would not have been possible for one of our big private companies to sell a reactor to Belgium. And so on.

This should tell us two things. First, the Government's job of research and development must be completed to its logical conclusion. Second, this must be done in such a way that the benefits and opportunities of atomic power development will be spread broadly, evenly, and justly throughout the economy, so that monopoly does not result, and so the American people, as a whole, are not called upon to pay twice over for a great resource for which they have already paid once.

As to our domestic economy, the question is this: Will the coming of atomic energy into our economic life have the effect which, even after its emasculation in 1954, the Atomic Energy Act still requires. The act says that atomic energy shall be so developed so as to strengthen the free-enterprise system and encourage competition. But the policies of the present Atomic Energy Commission and the practices

and natural self-interest of the electric power industry of the country are calculated to bring about precisely the opposite result.

After Edison invented the electric light we did not adopt a national policy of waiting until the kerosene lamp companies decided it was to their special interest to develop electricity on a commercial scale. New companies sprang up to develop a new industry.

Today our economy is showing unmistakable signs of age. This is not a pleasant nor a popular thing to say. But it is true. Unless something is done to change the present course we will find America's economic life as monopolistic as that of Western Europe. In a recent speech before the American Management Association, Mr. T. M. Evans, president of the H. K. Porter Co., said that the trend toward domination of our economy by a few giant corporations is "one of the quickest ways to socialism." He declared that unless the Government takes steps to ease the financing problems of small business, "competition will be eliminated in the next 5 or 10 years, and we will end up with 1 or possibly 2 large companies in each of the major fields."

I will not burden the committee with a lot of detail on this point. You are no doubt better acquainted with the facts than I am. Suffice it to point out that only a few years ago there were 60 oil refineries in Oklahoma whereas today there are only 16—and only 6 of these are independents; that as a result of a process of mergers during the past several years, 3 large corporations control nearly all of the processing of dairy products in this country; and that the only reason there is any competition at all in the electric power business is because some publicly owned projects and the rural electric cooperatives provide that competition to the private companies which, however, dominate the industry with an 80 to 85 percent control.

The House Small Business Committee recently showed that our 500 biggest corporations, each with assets of over $100 million, owned 51½ percent of all manufacturing assets in 1952, but had boosted this percentage to 57 percent in 1955. From 1953 to 1955 there was a net loss of 19,000 manufacturing companies in the country. If present trends continue, the committee asserted, these 500 firms will own all the Nation's factories by 1978.

Our largest corporation has an annual turnover of business equal to one-sixth that of the Federal Government, including all our defense expenditures. There is no longer the slightest possibility of a new company gaining access to the automobile business. Profit rates for General Motors average about 30 percent a year, but one can't exactly blame General Motors for this because, while this is clearly a monopolistic profit rate, nevertheless, if General Motors slashed prices they would probably run all their remaining competition out of business.

What we can blame is public policy that has permitted the automobile business to reach the point of no possible return to conditions of economic freedom or freedom of enterprise.

The power business is on the way to the same situation. It is a long way down that road. Once monopoly is established in the power business then we will be in for far more serious trouble than is the case with automobiles. For whoever controls a nation's power resource controls that nation's economy absolutely. And history has yet to record any monopoly that did not seek to maintain a scarcity of its product or service relative to demand and national need for it.

The American power companies have never proven an exception to this rule.

All these facts about the present alarming decline in economic freedom in the United States have got to be considered as we develop policy with respect to atomic energy.

Yet, our policy at present is to wait until the power companies get ready to develop it before we can have any real progress in peacetime uses of atomic energy. This despite the fact that the American people have paid $15 billion of tax money for the development of atomic energy and that beyond a shadow of doubt they, the whole people, own basic rights to atomic energy today.

The rate of progress of our nuclear-power program in the United States has been set by the private utility companies. It has been too slow a rate either for the Nation's safety or its welfare, or for justice to the people who have paid the bill.

There are only two agencies that can, at present, afford to develop, build, pay for, and operate atomic powerplants on a commercially practicable scale. The last figure I have seen, and I expect it is too low a one by now, is that $60 million is the minimum amount of investment required for a commercial scale atomic powerplant. Few companies indeed, and no small ones, can afford that kind of venture. Even the big power companies say that no one of them can do it. They ask substantial Government subsidy. They ask that the Utility Holding Company Act be amended to allow several of them to go together in building and owning atomic power. They insist that Uncle Sam foot the greater part of the insurance bill.

I think the Security and Exchange Commission has effectively repealed the Public Holding Company Act in its decision in the Power Reactor Holding Company case.

Among the large corporations of the country there are a handful which have had the tremendous advantage of participating with the Government in its atomic-energy projects. Add to this the fact that the compulsory licensing provisions of the original McMahon Atomic Energy Act were amended out of it in 1954 so that now private exclusive patents can be taken on even basic processes connected with atomic-power development. Personally I do not believe any special interest should be able to patent the energy of the sun.

This it is clear that if present AEC policies are continued and if Congress does not take remedial action, then the best we can expect is that some time, some day, we will begin to get atomic power from one or more of a mere handful of the mightiest corporations in the country. And they will control and own both the know how and the patent rights which will be the keys to participation in this new and revolutionary industry.

Aside from these few companies, or a combination of them, the only agency capable of pioneering the construction and operation of commerical scale atomic powerplants is the Federal Government. If the Government does it, its findings, processes, know-how, patentable discoveries will be available on equal terms to all American business, large and small, corporate and cooperative, private and public. Under such circumstances, we could hope for rapid development of practical uses of atomic energy. Atomic power could become the means of revitalizing and rejuvenating our economic system. True costs

of developing atomic power would be known for sure, by experience. They would not have to be gussed at. This may be very important in the future. The grip of monopoly would be loosened, maybe broken. There would be a chance for new companies to arise.

Power-short areas of the country would be power short no longer. No more would the decentralization of industry be hampered by the need to locate in areas adjacent to natural sources of power. But you gentlemen know far better than I the possibilities that exist if once atomic power can be produced at economically feasible costs. The big thing that has to be found out—and that can only be found out by practical operation of large-scale plants—is exactly how atomic power can be so produced.

These are the basic reasons why passage of the Gore-Holifield bill, or at least a measure including its basic features, is, in my opinion, the most important single duty of the present Congress.

It may be observed that all the reactors provided for by the Gore-Holifield bill would not supply anywhere near AEC's own need for electric power, which at last reports was, I believe, about 13 percent of total national consumption. Hence all the gains I am pleading for could be had without AEC actually selling a single kilowatt.

I have an additional reason for believing as I do. If we really want to maintain economic freedom, if we really want a true "people's capitalism," by which I mean broad participation in ownership, in responsibility taking, in risk taking and participation, if we want to have a minimum of governmental controls and regulations, if we also want to overcome the stultifying influences of monopoly, there is a very constructive way to accomplish all these objectives. That way is to have a portion, and it need not be such a very big portion, either, of various industries owned, capitalized, and effectively controlled by the users of their services and the customers for their products. Wherever a part of an industry is owned and controlled by the same people who buy its products or use its service, you have a built-in yardstick of economic pricing, quality of service, and, above all, adequacy of production. The people who own a business that serves their own needs must pay all costs of operation, including all taxes, of course. But they won't seek to profiteer at their own expense, nor to provide themselves with inadequate service or poor quality products.

Hence, the competitive impact of cooperative business, for that is obviously what I am talking about, is beneficial to everyone, even to their competitors. The mere fact that cooperatives, for example, carry on between 1 and 2 percent of various phases of the Nation's oil business led the president of an independent refinery association to remark, not long ago, that the major oil companies should be very grateful that the cooperatives are in their industry, since their very presence there proves that a degree of competition can still exist. And the presence of rural electric cooperatives in the field has caused rates charged rural consumers to decline as much as 50 percent from what they were before this consumer-owned competition was established by our farmers.

Naturally, therefore, I am deeply concerned that the rural electric cooperatives, which have contributed in such outstanding fashion to the progress and welfare of our country should take their full rightful place in atomic-power development. I know that three cooperatives

are now in preparatory stages of acquiring atomic powerplants. I hope and pray that they will turn out successfully and that they will prove economically practicable. But I confess I would feel a whole lot better about the outlook if the basic job which should have been done long since by AEC and which the Gore-Holifield bill would require it to do, had been done. I would feel a lot better if we had essential facts and data at hand from actual experience in building and operating full-scale atomic powerplants in the general public interest and with a view to national development and welfare.

The logical conclusion to the long and very expensive process of atomic energy development which we, as a nation, have gone through is to bring atomic energy into practical use. The construction and operation by the Government of admittedly very expensive prototype reactors and powerplants is the only way to bring research and development to that logical conclusion. This is a job for the AEC, or if it won't act, for some other public agency created by the Congress which will.

Let us finish the job. The firm base for broad development of atomic power in a free economic system has not yet been built. It won't be until we put the Nation's progress and welfare ahead of all special interests whatsoever. The Gore-Holifield bill proposes to do exactly that. It proposes to put the only logical keystone into the arch of atomic energy research and development. If that keystone is put in place, it will be no substitute for corporation and cooperative development, but rather the one sure way to bring about development by private corporate enterprise, private cooperative enterprise, and public bodies. In fact, I strongly suspect that much of the recent publicity about atomic power projects in 1 or 2 areas of the country has been prompted by the mere discussion of the Gore-Holifield bill. If so, actual passage of the bill would, without doubt, have many times this same beneficial effect.

We live at one of the great turning points in history. No small consideration should determine our actions at such a time. Atomic energy can be the death of man. It can be the death of economic freedom in America. But if our policies are based on justice to all the people and to all parts of our economy, if our policies seek only the general welfare of our Nation and the relief of burdens throughout the world, then the atomic age can be one of greater hope, greater justice, and more enduring peace than past ages have dared to dream of.

The CHAIRMAN. Thank you very much for a very thought-provoking statement. Senator Dworshak.

Senator DWORSHAK. I was intrigued by one statement you made—

> The rate of progress of our nuclear power program in the United States has been set by the private utility companies. It has been too slow a rate either for the Nation's safety or its welfare or justice to the people who have paid the bill.

Give us the reasons for the conclusion you have reached.

Mr. VOORHIS. Senator, I think that the statement is pretty well true. I am talking now about practical development. I am not talking about research.

Senator DWORSHAK. I realize that. The commercial aspects.

Mr. VOORHIS. The commercial aspects. I think the policy of the Atomic Energy Commission today is that commercial development

is to wait until private industry, which mainly I think means the public utility industry, is ready to develop this resource.

Senator DWORSHAK. For private motives or because they consider atomic energy as a competitive factor with more conventional means of power development?

Mr. VOORHIS. I think it is quite obvious—and I am not critical of the fact, I want to make clear—that under these circumstances it will be developed because they believe it profitable. I think that this is too important a matteer to be left until that happens, because if I were president of a private power company, I would have an interest, first, in not having power too abundant, particularly in power-short areas, and I would also have an interest in not having some of my present investment rendered obsolete by the development of a new industry that might change the industry very greatly. I think we have as a nation an interest and concern in this matter that transcends these special interests and that we must recognize that as a fact.

Senator DWORSHAK. That is all.

The CHAIRMAN. Mr. Price.

Representative PRICE. I will pass.

The CHAIRMAN. Mr. Cole.

Representative COLE. No questions.

The CHAIRMAN. Mr. Holifield.

Representative HOLIFIELD. I want to say that I appreciate your statement, and particularly your reference to the bill which Senator Gore and I introduced last year. I think in your response to Senator Dworshak you left one other point unsaid, and there are always many points which have been left unsaid in any discussion, but this point I think is a very important one.

At this state of the art, the investment of 50 or 100 million dollars in a reactor is almost inevitably doomed to be an uneconomic venture.

Mr. VOORHIS. It may well be.

Representative HOLIFIELD. Therefore, the president or the board of directors of a large corporation entrusted with their stockholders' funds would in my opinion be remiss in their duties and responsibilities to their investors if they deliberately went into a program to that extent which they in advance by all scientific advice were told would not be competitive with conventional fuel.

Mr. VOORHIS. That is correct.

Representative HOLIFIELD. So I do not put any blame on the private manufacturers of machinery or utilities for not risking these tremendous aggregations of capital. I think they would be possibly subject to legal attack if they did it deliberately. But the very fact that this situation exists is another factor on the delay of bringing this to a point of economic fruition.

Mr. VOORHIS. I think so. I think furthermore that even if they did take such a risk under those circumstances, they certainly would expect all the fruits of it to flow into their own control.

Representative HOLIFIELD. And rightly so.

Mr. VOORHIS. I think perhaps rightly so, but I think from the standpoint of the national interest that with the problem that I think we face with great concern of the possibility of our economy becoming more and more stratified as time goes on, and more and more highly controlled, that we cannot afford to let that happen, because whatever

the case may be in our time and for the next couple of decades with respect to the relative cost of atomic power compared to conventional power, I think almost everyone will agree that in our children's time that we are going to be dependent upon this source. Certainly if foreign countries make anything like the progress they are expecting, we would find ourselves in the eyes of the world almost a backward nation, if we do not participate.

The CHAIRMAN. Thank you very much, Mr. Voorhis. We appreciate your statement. You always give us good thought-provoking messages.

Mr. VOORHIS. I am very much obliged for the time. I only would like to say that I hope the committee knows that I realize the tremendous responsibility and task this committee has. I know it is not easy and I know you do not sleep nights very well. I am much obliged to this committee for the work it is doing. All citizens should be.

The CHAIRMAN. The next witness is Mr. Newton I. Steers, Jr., president of the Atomic Development Mutual Fund, Inc., of Washington, D. C.

STATEMENT OF NEWTON I. STEERS, JR., PRESIDENT, ATOMIC DEVELOPMENT MUTUAL FUND, INC.

Mr. STEERS. Mr. Chairman, I have a statement.

The CHAIRMAN. You may proceed.

Mr. STEERS. Like Mr. Voorhis, I appreciate the opportunity to appear before you as I have twice before.

I am president of Atomic Development Mutual Fund, Inc., an investment company first publicly offered just over 3 years and now holding assets of more than $40 million. As our name implies, we invest our shareholders' dollars in a variety of enterprises involved in the production or use of atomic energy. My job entails both selling and buying atomic energy. On the selling side, I talk frequently to investors and investment dealers who want to invest in atomic energy. On the buying side, I talk frequently to personnel in companies, the securities of which offer potential to those interested in investing in atomic energy. Our company then is a kind of conduit between the atomic investor and the atomic industry.

My comments are not intended as a summary of the investment status of the industry. I believe such information would be generally interesting, but not sufficiently closely related to your immediate task of legislation. I am therefore confining myself to a very few comments about the atomic scene as I see it.

VAST NEW INDUSTRY

A vast new industry looms in the near future. Contracts for more than $1.5 billion have been placed for Canadian uranium concentrates. The United States annual uranium production in 1958 will, according to the AEC, reach $300 million. Announced plans for civilian power production from the atom include the following, to be completed by the middle 1960's:

United States, 1.5 million kilowatts.
Japan, 3 million kilowatts.
Great Britain, 6 to 7.5 million kilowatts.

Euratom, 15 million kilowatts.

At $200 per kilowatt, this amounts to over $5 billion. At $300 per kilowatt, the figure becomes $7.5 billion. Commissioner Libby estimates up to 70 million kilowatts by 1975, at $300 per kilowatt, equal to $21 billion.

UNITED STATES MILITARY LEADERSHIP

The United States has led, and leads, in the two major military applications of the atom; weapons and propulsion. Can anyone doubt the tragedy if the United States is not the nation which brings the peaceful atom to fruition?

UNITED STATES CIVILIAN POWER PROGRAM

The United States plans only a fraction of the civilian kilowattage planned by other nations. This is because the United States has generally cheaper power than other nations; this, in turn, is based to a large extent on cheaper coal. Investor-owned utilities, in my opinion, deserve credit for having shown considerable audacity in their atomic plans, considering their fundamental responsibility to their shareholders. No doubt some of this audacity, from another point of view, could be termed fear—fear that public power will fill any vacuum left by private power. Abdication to public power is particularly easy in connection with the atom, which for so long was a government monopoly.

STATE OF THE ART

I think atomic-power costs can be summed under two headings: "Great Promise," "Great Uncertainty." The great promise stems initially from the promise of cheaper fuel, though fuel is, of course, but one element in power cost. The promise of cheaper fuel cost stems fundamentally from the revolutionary magnitudes of the fission energy of uranium as compared with the chemical energy of coal. Sometime later there is the promise of cheaper energy-extraction machines. That is, later reactors and associated equipment may be cheaper than coal-fired boilers. At present, however, it is assumed that competitive power cost will first be achieved through fuel enough cheaper to offset more expensive capital cost. The promise remains as it has been, very bright indeed.

The uncertainty, I am afraid, has not been gradually dispelled by the passage of time, as might naturally be expected. On the contrary, it has measurably deepened in recent months. Alco Products is finding costs on the Army package-power reactor $2 million more than expected. General Electric is finding costs on the Commonwealth Edison boiling-water reactor $15 million higher than expected. American Machine & Foundry has advised a utility that they will be unable to supply a reactor on which negotiation had begun. North American Aviation has found costs on its sodium-reactor experiment some $7 million higher than originally expected.

The uncertainty alluded to does not dim the ultimate promise, as one might suppose. This is because no one doubts that the difficulties will be overcome. It is only a question of when they will be overcome and by means of which general reactor design.

AEC POLICY

The AEC rightly has seen, in my opinion, that kilowattage is not in itself an index of success. We might well construct a large number of obsolete and high-cost reactors without deriving any real benefit. Hence the AEC is spending very substantial sums on development of new and improved reactor designs, and certainly such expenditures are thoroughly justified. The AEC also, it seems to me, is to be commended for its assistance to friendly foreign nations where power cost is higher and where supplies of fuel are more vulnerable than our own.

THE UNITED STATES DILEMMA

United States industry is faced by a dilemma which springs from one of its advantages. We want atomic power. We want cheap power. These are the horns of our dilemma. Our atomic leadership is threatened by our own low-cost power. How can this be, if we are engaged in the advanced research and development which will assure that our reactor designs will be the most efficient? The answer lies in the present state of reactor engineering. It is entirely possible to design in an advanced reactor which will, for the first copy built, produce less expensive power than another older design if the older design is built also only in one copy. But, if the older design is built in multiple, it may produce cheaper power than the first copy of the more advanced design. What is more, it may be easier to sell because of the demonstrated fact that it will work. This stems, of course, from the reduced costs possible with mass production. Even though assembly-line production of reactors may be out of the question, very large savings come from manufacture of multiple units. It is entirely possible that, assuming one or more of our advanced designs works, it will never be produced in quantity. While we are working on tomorrow's reactor, other people will make and sell today's reactors. The costs on today's reactors can be pointed to with finality. They may be high, but they will be known. The costs of tomorrow's reactors may look as though they will be lower, but they will not be known. In particular, the cost of producing them in multiple will not be known.

In my view, this is just what is happening with one of the leading purchasers here in our country. The United States Navy is buying pressurized-water reactors. Nearly everyone concedes the pressurized-water system will be supplanted probably by another system someday. In the meantime, pressurized-water reactors, it is known, will work. Costs are high, but they are known.

The British are in a fair way to sell gas-cooled reactors because costs are known; because it is known they will work.

Theories provide indispensable direction for scientific research. Estimates are indispensable precursors of actual costs. But people who are buying power reactors will rebel at buying a pig in a poke. And advanced design reactor costs will remain a pig in a poke until the reactors have been built.

Our policy may preserve our scientific leadership in the atomic field. But we are sacrificing our industrial leadership. If we continue to pursue tomorrow we will lose today. The world economy needs atomic energy today and it is willing to pay the cost of atomic energy today.

It will buy proven designs and buy them in countries where manufacturing costs are known.

Had we pursued only the short-run, economic incentive, we never would have seized atomic leadership. We seized it because of military incentive and it has paid off incalculably.

We are presently at the juncture where we are losing atomic leadership for the lack of short-run economic incentive. The long-run incentive is present, in that a large industry will emerge. Sales in foreign markets will be followed by sales in domestic markets. But the long-run incentive can only be responded to by the Government. The amount of money which still remains to be spent in order to translate estimates into actuals is too large and too uncertain for anyone but the Government.

If we follow our present policy, what will happen when tomorrow becomes today? We will then work on the reactor of the day after tomorrow, and other nations will sell the reactor of tomorrow, though by that time it will be semiobsolete, just as they will shortly sell today's reactor though it is now semiobsolete.

There are many others who can tell you what the advantages are of continued atomic leadership, or the disadvantages of lost atmic leadership. Suffice it to say that I believe we should go to great lengths to maintain that leadership, for international political reasons, for domestic economic reasons, and finally for military reasons. It may be that, just as military development of the atom has helped civilian development, so civilian development may aid military development.

THE DILEMMA RESOLVED

What then should we do? I believe we should build more reactors and try to build them immediately. However hard we try we cannot build them soon, let alone too soon. Indeed it is already dangerously late. Reluctantly I join the endless chorus of voices demanding more Federal spending. This spending may be distinguished in one respect at least from much other spending. It will not be for immediate and transient betterment of the average citizen's lot. It will be for a future betterment but an enduring one.

We can nail down costs only by building hardware in quantity—at least 2 million kilowatts more than is already planned and this should be done by 1960. Right now the incentive is not clearly enough revealed, the amount of money which must be spent is too large to expect private companies to accomplish the objective. We can maintain atomic leadership only by subsidizing the infant reactor industry—subsidize it by frankly building enough pressurized water reactors, enough boiling water reactors, enough reactors, even though they are immediately uneconomic so that genuine, actual multiple-unit manufacturing costs will be known.

This is really only an extension of what the AEC is already doing at Shippingport. It was known before Shippingport was started that it would be uneconomic. But its value has been very great, whether it produces 13-mill power or 52-mill power.

I will not attempt to specify what sorts of reactors should be built in respect of design. I do believe they should be full scale, in the neighborhood of 100,000 kilowatts each. This implies location in areas of high demand. I see no reason to put them in low-cost areas

where the uneconomic differential will be maximized. Rather they should be built in high-cost areas to minimize the cost differential.

The Shippingport subsidy formula has worked. It can be used more widely, probably in connection with other varieties of reactor design. To avoid the public-power controversy, let the new plants, as has been suggested, be bulit publicly and privately in proportion to the present capabilities of publicly owned and investor-owned utilities.

Additional "Shippingports" must be built by this country. If we don't someone else will, and atomic leadership with all its dramatic potentialities will be lost, never to be regained.

The CHAIRMAN. Thank you very much, Mr. Steers. Mr. Holifield.

Representative HOLIFIELD. No questions.

The CHAIRMAN. Mr. Cole.

Representative COLE. No questions.

The CHAIRMAN. Mr. Price?

Representative PRICE. No questions.

The CHAIRMAN. Senator Dworshak?

Senator DWORSHAK. No questions.

The CHAIRMAN. If there are no questions, thank you very much. Mr. STEERS. Thank you.

The CHAIRMAN. The next witness is Mr. Michael Michaelis, Arthur D. Little, Inc., Cambridge, Mass.

STATEMENT OF MICHAEL MICHAELIS, ARTHUR D. LITTLE, INC., CAMBRIDGE, MASS.

Mr. MICHAELIS. Mr. Chairman, my name is Michael Michaelis, and I am coordinator of the nuclear consulting services of Arthur D. Little, Inc. Our technical and economic services in this field are being rendered to clients in industry, finance, and Government agencies—both in this country and abroad. Though these activities have naturally contributed to the shaping of my views on national and corporate nuclear policies, I should make it clear, for the record, that my remarks that follow represent personal opinions and judgments, not necessarily those of my company or its clients.

Mr. Chairman, I am here at your kind invitation to give you—and the other distinguished members of this committee—I would like to apologize because it was only the day before yesterday that you should have full verbatim copies of the remarks here. I did give the committee a very rough draft and also brought along some short summaries, but I think I will depart in my remarks to some extent from my rough draft.

I am here to give you my thoughts on the worldwide impact of atomic power developments and on its relation to the American nuclear program. An understanding of the situation, though, is not sufficient by itself. For understanding is worth while only if it precedes action. With your permission, sir, I should like to put forward for your consideration some suggestions for action. To keep within the scope of your timetable today, I shall restrict my remarks to broad conclusions and recommendations, though I shall be glad to substantiate these in greater detail whenever you should so desire.

An understanding of the international situation led America to first use the phrase "atoms for peace" 3 years ago. A program for

action, based on this understanding and this concept, should comprise what I have chosen to call "atoms for trade."

"Atoms for peace," I believe, will become a reality—when "atoms for trade" is put into practice.

Since the President's declaration 3 years ago, patient negotiations have succeeded in shaping some of the international framework and political safeguards for the peaceful atom. It is now up to American industrial and commercial enterprise—backed by the necessary governmental action—to take the lead in vigorous worldwide atomic trade. In particular, I would urge the immediate setting up of partnership ventures jointly owned by American and foreign industry, to develop, build, and sell reactors and components.

Atomic power is the quintessence of atoms for trade. Trade implies profit; international trade in atomic power brings a threefold profit:

1. It fulfills the obligations of American world leadership and implements its stated foreign policy.

2. It provides greater financial incentives to American industry for getting on with the job of developing and building atomic powerplants, greater, that is, than the domestic market is likely to show for another decade at least.

3. It capitalizes on America's wasting asset—its preeminence in nuclear technology. Corporate equity—through joint ownership and operation with foreign interests of nuclear development and manufacturing facilities abroad—would give United States industry the long-term stake in world atomic-power markets that it might otherwise lose outright to foreign competition.

In other words, America's high stakes in international atomic power combine uniquely the commitments of foreign policy with the best short- and long-term interests of industry. But time is pressing, both from the political and the commercial point of view: At our own invitation the world is judging the United States on its ability to match with deeds the President's formal pledge before the United Nations; fast-growing technological skills abroad may make industrial cooperation with America seem less essential—in foreign eyes—as times goes on.

I would urge, therefore that in our deliberations on how to accelerate nuclear progress in this country we do not allow purely domestic considerations to deflect our attention from world opportunities that may not recur. The major nuclear-power markets are abroad, during the next decade at least. American industry should have its hands full competing there for profit. Moreover, the experience gained through this incentive will, in considerable measure, accelerate domestic technological progress and bring the day of competitive nuclear power closer in this coutry. But any vigorous approach to overseas markets requires undivided attention to an agreed purpose from both industry and Government; strong and visionary leadership must clear the technical, economic, and political obstacles that will undoubtedly be encountered.

The beginnings of the political framework of an international atomic operation are already being created through bilateral treaties, with the international agency, through Euratom and other OEEC ventures. So far so good.

I would like to say that the Commission and the Government has done excellent work, in my opinion, to stimulate all these measures for cooperation. But more I think is needed to bring about international cooperation in meaningful terms at the industrial level.

With your permission, sir, my remarks are in a way addressed as much to United States industry as to your committee.

To industry I would say: Be aware of the fact that large-scale export of atomic powerplants can, at best, be only a temporary phase in world atomic trade. Foreign countries—and I mean the more advanced mature economies of Western Europe and Japan—are perfectly capable of developing their own atomic skills and are intent on building their own plants as soon as possible. They do have a much more immediate need for atomic power than the United States. Our industry has very much of the know-how they desire and we should capitalize on it. The way to build up long-term stakes in the world atomic power market is for our industry to go abroad now and establish partnership ventures with foreign interests. These would be welcomed abroad because they would enable foreign atomic power projects to get started quickly.

To Congress I would say: Stimulate and help industry in every way possible to take a vigorous worldwide lead in atomic trade. It is true that this is primarily industry's responsibility, but the declared intent of our foreign policy—as embodied in the atoms for peace plan—is also at stake. If industry should be hesitant, in any way, because of existing regulations under the Atomic Energy Act, let us reexamine these provisions to clarify, and—if necessary— to change them. At all events, let us do everything possible to follow through on atoms for peace by encouraging practical working partnerships—at the industrial level—with our friends abroad. What I am talking about in many ways is a breakthrough of psychological barriers that have been created through what appears to industry in this country to some extent and to our foreign friends as restrictive legislation.

An analysis of the world's nuclear-power markets is a complex task. In the absence thus far of definitive and proven economic evaluations of nuclear power, the results are inevitably influenced, to some extent, by one's personal optimism. Though I confess outright to being an optimist, I would hope that this trait has not warped realistic judgments.

Some of the most startling world trends concern the explosive growth of population and of energy consumption. The current population growth rate of 1½ percent per year shows no signs of slackening. About 80,000 more people live in the world every day. We may well see a doubling of the population by the year 2000—5 billion to be fed, clothed, and sheltered. As industrialization spreads, energy consumption is growing at an even faster pace than population, the current world average being about 3 percent each year. Projected estimates point to a possible fourfold to sevenfold increase in world energy requirements during the next 50 years. The divergence among estimates is much less important, however, than the fact that the anticipated rate of increase is sufficiently high to throw into stark relief the inadequancy of finite reserves of hydropower and fossil fuels, the latter being, of course, irreplaceable. Even though indigenous reserves in many countries still seem ample, on the face of it, these

potential resources are all too often uneconomical to use, being geographically too remote from the hubs of industry.

Turning from the general to the particular we must, for our purpose of defining nuclear-power markets, differentiate between various regions of the free world in relation to their power requirements.

It is customary to speak of "haves" and "have nots"—of "industrialized" and "underdeveloped" countries. More recently, however, leading economists (like Professors Millikan and Rostow at the Massachusetts Institute of Technology) are thinking of countries grouped into three categories: The first group (i. e., the most underdeveloped) being in a "preconditioning" phase, the second in a "transitional takeoff" phase undergoing fairly rapid industrialization, and the third having reached "self-sustaining growth."

The last group comprises mature industrial economies, including the United States, most of Western Europe, and to a slightly lesser extent perhaps, some other regions, such as Japan and parts of Australia and New Zealand. These countries show long-term trends in national product and economic behavior that assure, for the average, a relatively high rate of capital formation and continued growth in productivity. (Specific criteria for this group show gross national product increasing at a rate of 5–10 percent per year, with not less than 15 percent of GNP being reinvested in the economy to further increase productivity.)

The second group, in the transitional takeoff phase, comprises many countries in Latin America and some regions in Oceania and Asia. (These are countries whose GNP has grown at a rate greater than 3 percent per year for two consecutive decades, with at least 5 percent of GNP being plowed back into the economy.) They are as yet unable to form capital at a rate sufficient to sustain all growth processes within their respective economies. Significant interaction between, and integration of, different sectors, such as agriculture, manufacturing, and transportation, however, have already occurred.

The first group in the preconditioning phase includes almost all of Africa and Asia. Their economies have been essentially static for long periods of time; capital formation is very low or nonexistent; transportation, urbanization and the growth of entrepreneurial and commercial classes is slow. Great differences exist, of course, between the various countries of this group.

India, for instance, is likely to enter the takeoff phase soon, her GNP now growing at 2 to 3 percent annually and expected to double at the end of the next 5-year plan; her investment is about 5 to 7 percent of GNP per year and is also expected to double. India's administrative and entrepreneurial abilities are already notable. Her main problem is economic, in the sense of needing additional capital formation. Indonesia, on the other hand, for instance, would seem to require considerable social and cultural changes before even additional capital would be of lasting benefit to her economy. The development of a commercial class and of transportation is an example of the prerequisites for her economic growth that availability of neither capital nor power could replace.

I have dwelt on this tripartite economic division of the free world in order to put into rational perspective the glib assumptions often made by enthusiasts that nuclear power is a panacea that will bring prosperity to all—and soon.

For the preconditioning or underdeveloped countries this would not seem to be the case at present, except possibly in some isolated instances where nuclear power may be economical to use: for instance in remote mining operations. Let me emphasize, though, that emotional aspirations to get in on the ground floor of the new scientific—synonymous with atomic—revolution are as strong, if not stronger, in this group of countries, many of whom have but recently emerged from western political domination. The West must act circumspectly if it is to gain the freely given friendship of these uncommitted countries. Any attempt to brush off their atomic hopes as entirely utopian is likely to lead to frustration and recrimination which can only be in the interests of the Soviet bloc.

Before going on to an evaluation of nuclear-power markets in the other two groups of countries, I might make a few summary remarks on the relative commercial attractiveness of nuclear versus conventional thermal powerplants.

I believe it reasonably safe to say that large nuclear-power stations—100,000-kilowatt capacity or greater—can be built by American industry in the next 5 years, which could produce electricity as economically as thermal plants and could begin to show some return on investment. But here is the rub: Only in areas where coal prices or their equivalent are $10.50 per metric ton or greater.

Returns on investment—after depreciation—would run roughly as shown in table I.

Another feature of nuclear-power economics worth emphasizing is this: Because of their relatively high capital and low operating costs, nuclear plants will be economical primarily for supplying base loads. A combination with hydroelectric or thermal-power stations seems advantageous in cases where large fluctuations in peak load are anticipated.

I cannot overemphasize, of course, that these comparisons are based on assumptions regarding the capital cost of the nuclear plant, its fuel and inventory costs, its operating and maintenance costs, and its plant life. None of these assumptions have yet been proved in commercial practice, though informed opinion considers them reasonably realistic.

Bearing in mind these general guideposts of nuclear-power economics, we can take a closer look at the potential markets.

In the group of mature industrial economies—principally the United States and Western Europe—we note the assurance of continued high rates of capital formation and growth of productivity. Both factors are conducive to the introduction of nuclear power, but driving forces of economic motivation differentiate the United States from other countries in this group.

America's relatively greater reserves of coal, oil, and gas, available at low cost, lessen the economic incentive for immediate domestic utilization of nuclear power. With the price of coal at around $8 per ton or less in most industrial centers, it is evident that nuclear plants cannot yet hope to compete with conventional ones, let alone pay out any returns on investment. It is likely to be another decade at least, I believe, before we can expect nuclear plants to be installed in this country for reasons of commercial profitability alone. The next 10 years could be lean years profitwise for the American nuclear industry. This lack of financial incentives was cited as a major roadblock toward atomic progress by over 30 percent of some 170 companies

recently polled by the Atomic Industrial Forum. It is my strong impression that it is the most important single industrywide retarding factor.

The picture abroad is rather different. The price of indigenous fuel in Western Europe ranges from $10 per ton upward, and local supplies are insufficient to meet demand. Imported supplies cost as much as $20 per ton of coal or its equivalent. Within the next 10 years, Europe's energy needs will exceed indigenous production by more than 40 percent—double the gap today. Most of this gap must be filled by greater imports of conventional fuels, mainly oil and some coal. The Suez dilemma though, all else aside, is a dramatic reminder of the precarious position of Europe's major fuel imports. Alternative supplies from the Western Hemisphere could be as scarce as dollars are to pay for them. Europe must become self-sufficient in energy resources. Atomic power, therefore, is regarded as the hope for Europe. Only last December, Britain raised her aim for projected nuclear powerplants by 2 to 3 times over estimates made only 6 months earlier. Total installed capacity of around 6 million kilowatts is now planned for 1965.

Closely parallel thinking is found throughout most of Europe, though technological progress is not yet as far advanced as in Britain. To accelerate progress, various types of regional pooling of resources are under discussion. Euratom is expected to be created sometime next month. Three representatives of this organization who visited you here in Washington a few weeks ago, sought not money but American technical information and atomic fuel. Their assignment of determining how fast and how big a network of nuclear powerplants can be created in Europe has resulted in tentative aims set at 3 million kilowatts by 1962 and 15 million kilowatts by 1967.

To repeat, lack of indigenous fuel and high-cost imports are urgent motivations toward nuclear power in most mature industrial economies other than the United States. Moreover, their financial equation for competitive nuclear power does not, unlike ours, rest only on a straight comparison of total costs for nuclear as against conventional plants. In some cases, foreign-exchange quotas exert a further powerful leverage, in that a prolonged and increasing demand for foreign fossil fuels will aggravate an unfavorable balance-of-payments position. A premium of present-day higher capital costs for nuclear plants might therefore be acceptable in view of long-term financial savings through lesser fuel imports.

Japan, for instance, now spends about one-third of all her dollar and sterling credits—clearly a disproportionately large large sum of vital foreign currency—for costly fuel imports. This one example, typical of many others, is indicative of the industrial inertia and consequently lessened chances for improving living standards that are caused by high fuel costs. In 1952, the average Japanese consumed energy equivalent to 1.1 metric tons of coal and earned the equivalent of 165 United States dollars; for the average Briton it was 4.6 tons of coal and $715; for the average American, 8.2 tons and $1,857.

To all these economic pressures, then, atomic power offers some hope of ultimate relief. Within the next decade, the market for nuclear power in Europe and Japan might well amount to 15 million kilowatts, as compared with some 2 to 3 million kilowatts likely to be built in

the United States for purposes of long-range technological development of economical domestic plants. Moreover, this foreign market calls for large-size power units to supply base loads. As I said earlier, American technology should be capable of building such nuclear plants within the past few years to provide power at prices that are attractive on the European market.

There are two important factors, though, that America must bear in mind:

The first is positive; that is to say, the European market does offer a competitive proving ground for our nuclear goods and services and provides immediate financial incentives for our industry, provided that, secondly, we recognize Europe's clearly stated aim to become self-sufficient, as soon as possible, in the manufacture of nuclear reactors and fuels.

In other words, I believe it essential to consider the European market for nuclear power as a joint partnership enterprise between American and European manufacturers. Any thought, on our part, of exporting complete plants and providing ancillary services over an extended period of time would seem unrealistic. Some will be sold, undoubtedly, since speed is of the essence, but in the longer run Europe has the technical capabilities of manufacturing the equipment; it lacks the know-how to do so at once. Europe has the need; American industry has the know-how. We should seek to capitalize on it, and I would urge that equity arrangements, such as nuclear-manufacturing plants located abroad and jointly owned by American and foreign interests, be considered immediately. Licenses are an additional source of revenue, though I understand—and I say this with some trepidation, not being a lawyer—that the patent provisions of our Atomic Energy Act leave something to be desired in this respect, at least as seen from the profit-motivated viewpoint of industry.

Representative HOLIFIELD. I notice you ask for this joint partnership arrangement between private corporations in this country and private corporations abroad.

Mr. MICHAELIS. That is right.

Representative HOLIFIELD. Is it not true in England most of the companies there are actually fronts for the Government? They are Government-owned corporations that are dealing in the production of atomic-energy plants?

Mr. MICHAELIS. No; I do not believe that is so.

Representative HOLIFIELD. You think it is private companies that are doing it?

Mr. MICHAELIS. Yes; the reactor companies are private companies. In England some 6 groups of companies have gotten together, each group comprising 2 or 3 companies, an electrical manufacturing, a civil engineering group, and so on. They are bidding on contracts for atomic power plants let by the Government because electric utilities are Government-owned in England. But the manufacturing groups are private companies.

Representative HOLIFIELD. What impediment is there to a private company in England and private company in United States joining together in mutual development? Are you speaking of legislation?

Mr. MICHAELS. I think there may be some legislation involved. Existing restrictive legislation has created a psychological barrier.

As an example of the kind of restrictive legislation I am thinking of in this respect is the provision in the Atomic Energy Act that says that no American company may engage in any activity that would manufacture fissionable material abroad. I know the act also says that such activities may be authorized—if in the national interest—but they are not specifically encouraged in the act. It is a restrictive feature. This is one example.

Another example is the insurance question. Just as much as it bothers us at home, any partnership venture which would imply American equity invested in a jointly owned reactor manufacturing plant abroad, might involve an international insurance question. The present bilateral treaties say that foreign governments will indemnify the American Government against any liability that may arise. I am not sure this extends to private companies. These are just two examples.

Representative HOLIFIELD. I wondered if it was a change in policy or a change in legislation that was needed.

Mr. MICHAELIS. Both I think. It may involve some change in legislation if only to the extent of encouraging practical international cooperation rather than making it appear restrictive. Since you mentioned England specifically, I may venture the guess that American participation in the British nuclear power program may already be too late at this advanced stage of British progress. I think more likely immediate partners are to be found in the rest of Europe.

Representative HOLIFIELD. It might apply to France, Italy, or somebody else?

Mr. MICHAELIS. Yes; certainly any of the others.

In the availability of nuclear fuel, we run up against a problem that requires careful consideration lest it prove a serious stumbling block to American-European cooperation. Our prototype reactors in this country are fueled with enriched uranium which have seemed to us the more promising types to develop—for the long-range domestic market. Europe, on the other hand, has no fuel-enrichment facilities as yet. Even Britain, with such facilities—limited in availability, though, by weapons requirements—is going the way of building natural-uranium-fueled powerplants. The economics of these plants, though anticipated to be inferior to enriched-uranium types over the long run, are still adequate for Britain's immediately foreseeable needs. Some of her European neighbors seem inclined to think likewise in regard to their own situation.

Proponents of enriched-uranium fuel who are clamoring for the communal building of an enrichment plant in Europe are countered by arguments that the future availability of plutonium from natural-uranium reactors will permit fuel enrichment to be carried out when it becomes economically necessary. "Therefore let us build natural-uranium reactors first" is the suggestion that seems to be winning some favor in European eyes. For in spite of President Eisenhower's offer of considerable amounts of enriched fuel for foreign consumption, there is a strong feeling in Europe and elsewhere that such complete dependence, even temporarily, on American supplies would be unhealthy. One might hope, though, that international political developments, such as the establishment of the International Atomic Energy Agency, the emergence of Euratom, as well as other cooperative nuclear ventures sponsored in Europe by the Organization for

European Economic Cooperation, and the more liberal interpretation of bilateral treaties, will soon progress to the point where some of these seemingly intangible considerations will cease to be major obstacles to trade in enriched uranium.

If Europe should then feel free to choose enriched fuel, American industry is all set to trade. Even in the natural-uranium field we have a good deal to contribute. Indeed, AEC's most recent invitation to United States industry for bids on reactor development gives top priority to natural-uranium types. Now, should it not be possible for United States companies to undertake such developments jointly with some European or Japanese companies and for such plants to be sold in places where they would not pay their way; namely abroad? It is obvious enough that such a proposal is beset with difficulties of all kinds: security considerations, international legal matters, and insurance laibilities are critical examples. But I do suggest that very serious consideration should be given to this proposal and I believe that ways can be found to solve the problems. Of this I am certain: The effort is indisputably worth making from American industry's point of view. And from a foreign policy aspect, I can think of few more dramatic and practical ways to implement our principles. Considering our friends abroad as working partners—each of us entitled to his share of profits—rather than as recipients of technical aid, grants, and the like, would give real meaning to atoms for peace.

So much for Europe and the other mature industrialized countries.

What of the intermediate group, where the pace of industrialization is quickening: Countries in Latin America, such as Brazil, Bolivia, and Argentina, and some areas of Asia, notably parts of India. The rate of increase of energy consumption tends to be higher in this group than in either of the other two. But these regions possess neither the technology nor the resources to build their own powerplants. Also, domestic capital formation is likely to be inadequate in all but very few exceptions for the financing of any major power scheme. All of this spells almost complete dependence on foreign imports and investment.

Experience indicates that powerplants, other than hydroelectric, are required in the range of 1,000 to 10,000 kilowatt capacity units. This suggests that reactors of small size, using enriched fuel are needed. In other words, this market is clearly one for the export of complete nuclear plants of a kind that United States industry is now uniquely qualified to construct. The 10,000-kilowatt nuclear plants slated by American & Foreign Power for three Latin American countries are typical examples of such exports.

Analysis of a considerable number of currently installed diesel units shows that the average station capacity is just over 4,000 kilowatts, operating at load factors at about 30 percent, with electricity costs around 22 mills per kilowatt-hour. It would be unrealistic to imagine that a nuclear plant could soon compete with diesel power at these low load factors. However, a reactor could form part of an integrated system, bearing a high baseload factor itself, with diesel engines used for standby and peak loads. Recent estimates indicate that the cost of electricity generated by a 5,000 kilowatt nuclear plant, operating at an 80 percent plant factor, could soon reach the 23 to 28 mills per kilowatt-hour range. Remote mining areas, for

instance, would seem to have need for plants of just about this specification; their current diesel-electric costs are often in excess of 25 mills. Their number may be expected to increase as the global search widens for new sources of raw materials.

Estimates for the whole group of industrializing countries indicate a potential for about 1,500,000 kilowatts of installed nuclear power during the next 10 years. Also included in this figure are some of the smaller size nuclear units that might be used in the underdeveloped countries, and—indeed—the mature economies as well. Wood-pulp mills in Scandinavia and northern Canada, for instance, offer possibilities for such nuclear plants to generate process steam.

All in all, the nuclear "package power" concept has much to commend it as a world-trade commodity. Infrequency of refueling would enable it to economically open up the new raw-material resources upon which the world's future industrial growth will so largely depend. The size of the market apparent even today suggests that sufficient package units are needed to permit some degree of standardization and, therefore, mass production. Consequent economy of manufacture could well bring the cost of nuclear power down to attractive levels. Here again, cooperative equity arrangements between American and foreign reactor builders could assure a long-term stake in these markets. Though our industry might capture the market now—because of our lead in enriched-uranium reactors—we might ultimately lose a substantial portion to the less expensive foreign manufacturer who has been a major traditional supplier of this market.

In summary, we can see a total free-world market for nuclear power of 19 million kilowatts during the next decade. This market breaks down roughly as follows:

United States, 2.5 million kilowatts.
Great Britain, 5 million kilowatts.
Europe and Japan, 10 million kilowatts.
Industrializing and underdeveloped countries, 1.5 million kilowatts.

Without going into all the ins and outs of foreign competition, it would seem reasonable to expect that American industry might be able to get say 35 to 40 percent of the revenues derived from foreign markets for nuclear-power equipment, its share being equivalent to about 6 million kilowatts of installed capacity during the next 10 years. Contrasting this with the domestic market, during the same period, of about 2.5 million kilowatts, we recognize the importance of worldwide trade to the American nuclear industry in its growth to commercial profitability.

As I said earlier, we should not allow a natural preoccupation with the internal policies of our domestic nuclear program to deflect our attention from the vital opportunities and obligations abroad. During the decade ahead, the urgency and incentives for atomic-power developments will stem not from domestic but from international pressures. Positive action is required from this country above and beyond what would seem adequate for domestic needs alone; action that could—simultaneously—implement our stated foreign policy, provide much-needed financial incentive for our industry, capitalize on the wasting assets of our technological preeminence, and accelerate our domestic nuclear progress.

Such action, I suggest, should be based upon the concept of joint partnership ventures between American and foreign industry—mainly in Canada, Europe, and Japan—to develop, build, and sell nuclear power reactors, their components and ancillary services. Both Government and industry in this country should give urgent attention immediately to solving the international problems that will arise, in such a manner as to avoid the political rigidity that has sometimes seemed to characterize American attempts at international cooperation. Only then will these joint nuclear enterprises become possible. Among the problems are such outstanding matters as security classification, patent provisions, international insurance of hazards, and "strings" on nuclear fuels and their reprocessing. Congressional action is likely to be needed to overcome some of these obstacles to "Atoms for Trade." We may well need a bill "to accelerate international atomic power developments." Its passage and implementation would result in a natural acceleration of the domestic program as well.

The CHAIRMAN. Thank you very much for a very excellent statement.

At this point we will insert your entire statement in the record.

(The statement referred to follows:)

STATEMENT OF MICHAEL MICHAELIS, COORDINATOR OF NUCLEAR CONSULTING SERVICES, ARTHUR D. LITTLE, INC., CAMBRIDGE, MASS., FEBRUARY 28, 1957

ATOMS FOR TRADE

A PROPOSAL FOR INTERNATIONAL INDUSTRIAL PARTNERSHIPS TO DEVELOP ATOMIC POWER

Mr. Chairman, my name is Michael Michaelis. I am coordinator of the nuclear consulting services of Arthur D. Little, Inc. Our technical and economic advisory services are being rendered to clients in industry, finance, and Government agencies—both in this country and abroad. Though these activities have naturally contributed to the shaping of my views on national and corporate nuclear policies, I should make it clear, for the record, that my remarks that follow represent personal opinions and judgments, not necessarily those of my company or its clients.

Mr. Chairman, I want to thank you for extending me the privilege of appearing before your committee at this crucial time. This year the American nuclear industry is going to reach a turning point in its young history when decisions of vital importance will have to be made. This turning point is being brought about by international and not by domestic pressures. Western Europe, in particular, is faced with the immediate necessity of embarking upon a very ambitious nuclear-power program. In brief, we must decide how best to participate with our friends abroad in developing the free world's atomic-power resources. I believe the best way to be through partnerships between American and foreign corporations to develop, build, and sell atomic-power equipment in the world's markets.

Current and past hearings of this committee, Mr. Chairman, have, on the one hand, been concerned with the balance between public and private interests in the proposed acceleration of our domestic atomic-power program. On the other hand, we have discussed our role in international developments. I believe that we have been unwise to differentiate so strictly between domestic and international problems and that we are therefore finding it harder to solve either one or the other. Both can be solved—simultaneously, I believe—by a realistically unified approach.

Essentially, we are faced with two questions:

1. Where are the immediate financial incentives for American private enterprise to develop atomic power? The answer is: Mainly abroad—during the next decade at least. Since the major markets are abroad, much of our industrial effort should be abroad.

2. Why do we want to accelerate the domestic program? America's economic need for atomic power is not so drastic as to make our current long-term de-

velopment program seem inadequate. Neither are we interested in a "kilowatt race" with other nations for reasons of prestige alone. The major immediate reason for accelerating the domestic program must clearly be to maintain America's technological preeminence so as to participate more adequately in world developments.

The answers to these questions, I submit, should make us reconsider corporate and national policies vis-a-vis atomic power. An acceleration of the American program, along purely domestic lines, cannot strike a balance between Government and industry responsibilities, particularly in regard to financial support, that is going to find all interested parties in agreement. The testimony at these hearings makes this amply clear.

I urge, therefore, that we turn our deliberations away from purely domestic policies and look instead at the total world picture of atomic-power developments. I believe that, in so doing, we can evolve an action program, a program that I have chosen to call "atoms for trade," which will logically fit the needs of the situation in all major aspects for the short and the long term. The principal feature of "atoms for trade" should, I believe, be partnership ventures between American and foreign corporations (mainly in Western Europe, Canada, and Japan) to develop and build nuclear-power equipment and to sell it in the free-world markets wherever the need for it exists.

We can see a total free-world market for nuclear power of 19 million kilowatts during the next decade. Since we are very short of time at this session of the hearings, Mr. Chairman, I should like to ask that a supporting statement for this market analysis be read into the record. (See appendix.) This market breaks down roughly as follows:

	Million kilowatts
United States	2.5
Great Britain	.5
Europe and Japan	10.0
Industrializing and underdeveloped countries	1.5

It seems reasonable to expect American industry to get say 35 to 40 percent of the revenues derived from foreign markets for nuclear-power equipment, its share being equivalent to about 6 million kilowatts of installed capacity during the next 10 years. Contrasting this with the domestic market, during the same period, of about 2.5 million kilowatts, we recognize the importance of worldwide trade to the American nuclear industry in its growth to commercial profitability.

Atomic power is the quintessence of "atoms for trade." Trade implies profit; international trade in atomic power brings a threefold profit:

1. It fulfills the obligations of American world leadership and implements its stated foreign policy.

2. It provides greater immediate financial incentives to American industry for getting on with the job of developing and building atomic powerplants; greater, that is, than the domestic market is likely to show for another decade at least. It thus accelerates the natural growth of our nuclear-equipment industry and brings the day of "competitive" nuclear power closer in this country.

3. It capitalizes on and maintains one of America's chief assets: its preeminence in nuclear technology. Corporate equity abroad, through joint ownership by American and foreign interests of nuclear development and manufacturing facilities, would give United States industry the long-term stake in world atomic-power markets that it might otherwise lose outright to foreign competition.

In other words, America's high stakes in international atomic power combine uniquely the commitments of foreign policy with the best short- and long-term interests of industry.

But time is pressing, both from the political and the commercial point of view. At our own invitation the world is judging the United States on its ability to match with deeds its formal atoms-for-peace pledge before the United Nations; fast-growing technological skills abroad may make industrial cooperation with America seem less essential, in foreign eyes, as time goes on.

We, therefore, need, and need urgently, a definitive program of joint action by both Government and industry. Such a program should be aimed at stimulating and enabling American private enterprise to go into partnership with foreign industry to develop, build, and sell atomic-power equipment throughout

the free world. The beginnings of a political framework for international atomic cooperation are being created through bilateral treaties, through the International Atomic Energy Agency, through Euratom and OEEC ventures. So far so good, but more is needed to bring about international cooperation in meaningful terms at the industrial level.

My remarks are addressed as much to United States industry as to Congress, Mr. Chairman.

To industry I would say: Be aware of the fact that large-scale export of atomic powerplants, can, at best, be only a tempory phase in world atomic trade. Foreign countries are perfectly capable of developing their own atomic skills and are intent on building their own plants as soon as possible. They have a much more immediate need for atomic power than the United States. But American industry now has atomic know-how on which it should capitalize. The way to build up long-term stakes in the world's atomic-power markets is for United States industry to go abroad now and establish partnership ventures with foreign interests. These would be welcome abroad, for they would enable foreign atomic-power industries to get started quickly.

To Congress I would say: Stimulate and help industry in every way possible to take a vigorous worldwide lead in atomic trade. It is true that this is primarily industry's responsibility, but the declared intent of our foreign policy, as embodied in the atoms-for-peace plan, is also at stake. If industry should be hesitant, in any way, because of existing regulations under the Atomic Energy Act, let us reexamine these provisions to clarify, and, if necessary, to change them. At all events, let us do everything possible to follow through on atoms for peace by encouraging practical working partnerships, at the industrial level, with our friends abroad.

Both Government and industry in this country should give urgent attention immediately to solving the international problems that will arise, in such a manner as to avoid any political rigidity that could make cooperation undesirable in foreign eyes. Only then will these joint nuclear enterprises become possible. Congressional action may well be needed to overcome obstacles to atoms for trade; it may require an act to accelerate international atomic-power developments. Such an act would not only remove the psychological barriers to international cooperation that past restrictive legislation has allowed to grow up in the minds of both American and foreign industry. It should also embody positive provisions with regard to such problems as international insurance of nuclear hazards, international trade in fissionable material, international patent rights, and, of course, continuing declassification. Such an act would clearly need to be closely aligned to the emerging pattern of political bilateral and multilateral treaties relating to nuclear energy. I believe that this can be done and, furthermore, that a sufficiently nonrestrictive environment can be created, within the bounds of national security, to stimulate American industry to develop atomic power together with its industrial partners abroad.

International industrial partnerships would, simultaneously, fulfill our foreign-policy objectives, provide short- and long-term incentives for our industry, capitalize on our wasting assets of technological preeminence, and accelerate our long-range domestic program as well. Last, but not least, we would resolve the current soul-searching questions in this country about the relative roles of Government and industry by taking the only practical way that allows private enterprise to invest its money in building atomic-power equipment with a reasonable expectation of early and adequate financial returns from commercial markets.

We must act soon. For, to the rest of the industrialized countries of Western Europe, atomic power is essential, and these countries will have to go ahead with practical plans, regardless of our actions. For a limited time, at least, joint industrial enterprises would be welcomed by European industry. I urge again that in our deliberations on how to accelerate nuclear progress in this country we do not allow a natural preoccupation with the internal policies of our domestic nuclear program to deflect our attention from world opportunities that may not recur. During the decade ahead, the urgency and incentives for atomic-power developments will stem not from domestic but from international pressures. Positive action is required from this country above and beyond what would seem adequate for domestic needs alone.

Atoms for peace will become a reality when atoms for trade is put into practice.

These are my proposals. I sincerely hope they are of some interest to you, Mr. Chairman.

APPENDIX

WORLD MARKETS FOR ATOMIC POWER

An analysis of the world's nuclear-power markets is a complex task. In the absence thus far of definitive and proven economic evaluations of nuclear power, the results are inevitably influenced, to some extent, by one's personal optimism. Though I confess outright to being an optimist, I would hope that this trait has not warped realistic judgments.

Some of the most startling world trends concern the explosive growth of population and of energy consumption. The current population growth rate of 1½ percent per year shows no signs of slackening. About 80,000 more people live in the world every day. We may well see a doubling of the population by the year 2000—5 billion to be fed, clothed, and sheltered. As industrialization spreads, energy consumption is growing at an even faster pace than population, the current world average being about 3 percent each year. Projected estimates point to a possible four- to seven-fold increase in world energy requirements during the next 50 years. The divergence among estimates is much less important, however, than the fact that the anticipated rate of increase is sufficiently high to throw into stark relief the inadequacy of finite reserves of hydro power and fossil fuels, the latter being, of course, irreplaceable.

Even though indigenous reserves in many countries still seem ample, on the face of it, these potential resources are all too often uneconomical to use, being geographically too remote from the hubs of industry.

Turning from the general to the particular we must, for our purpose of defining nuclear-power markets, differentiate between various regions of the free world in relation to their power requirements.

It is customary to speak of haves and have-nots—of industrialized and underdeveloped countries. More recently, however, leading economists (like Professors Millikan and Rostow at the Massachusetts Institute of Technology) are thinking of countries grouped into three categories: The first group (i. e., the most underdeveloped) being in a preconditioning phase; the second in a transitional takeoff phase undergoing farily rapid industriatization; and the third having reached self-sustaining growth.

The last group comprises mature industrial economies, including the United States, most of Western Europe, and to a slightly lesser extent perhaps, some other regions, such as Japan and parts of Australia and New Zealand. These countries show long-term trends in national product and economic behavior that assure, for the average, a relatively high rate of capital formation and continued growth in productivity. Some criteria that can be used as rules of thumb to characterize members of this group are gross national product increasing at a rate of 5 to 10 percent per year, and not less than 15 percent of GNP being reinvested in the economy to further increase productivity.

The second group, in the transitional takeoff phase, comprises many countries in Latin America and some regions in Oceania and Asia. These are countries who GNP has grown at a rate greater than 3 percent per year for 2 consecutive decades, with at least 5 percent of GNP being plowed back into the economy. They are as yet unable to form capital at a rate sufficient to sustain all growth processes within their respective economies. Significant interaction between, and integration of, different sectors, such as agriculture, manufacturing, and transportation, however, have already occurred.

The first group in the preconditioning phase includes almost all of Africa and Asia. Their economies have been essentially static for long periods of time: capital formation is very low or nonexistent; transportation, urbanization, and the growth of entrepeneurial and commercial classes is slow. Great differences exist, of course, between the various countries of this group. India, for instance, is likely to enter the takeoff phase soon, her GNP now growing at 2 to 3 percent annually and expected to double at the end of the next 5-year plan; her reinvestment is about 5 to 7 percent of GNP per year and is also expected to double. India's administrative and entrepreneurial abilities are already notable. Her main problem is economic, in the sense of needling additional capital formation. Indonesia, on the other hand, for instance, would seem to require considerable social and cultural changes before even additional capital would be of lasting benefit to her economy. The development of a commercial class and of transportation is an example of the prerequisites for her economic growth that availablity of neither capital nor power could replace.

I have dwelt on this tripartite economic division of the free world in order to put into rational perspective the glib assumptions often made by enthusiasts that nuclear power is a panacea that will bring prosperity to all—and soon. For the preconditioning or underdeveloped countries this would not seem to be the case at present, except possibly in some isolated instances where nuclear power may be economical to use: for instance in remote mining operations. Let me emphasize, though, that emotional aspirations to get in on the ground floor of the new scientific—synonymous with atomic—revolution are as strong, if not stronger, in this group of countries, many of whom have but recently emerged from western political domination. The west must act circumspectly if it is to gain the freely given friendship of these uncommitted countries. Any attempt to brush off their atomic hopes as entirely utopian is likely to lead to frustration and recrimination which can only be in the interests of the Soviet bloc.

Before going on to an evaluation of nuclear-power markets in the other two groups of countries, I might make a few summary remarks on the relative commercial attractiveness of nuclear versus conventional thermal powerplants. I believe it reasonably safe to say that large nuclear-power stations (100,000-kilowatt capacity or greater) can be built by American industry in the next 5 years, which could produce electricity as economically as thermal plants and could begin to show some return on investment. But here's the rub: Only in areas where coal prices or their equivalent are $10.50 per metric ton or greater. Except in very isolated instances, fuel in the United States is cheaper.

Another feature of nuclear-power economics worth emphasizing is this: Because of their relatively high capital and low operating costs, nuclear plants will be economical primarily for supplying base loads. A combination with hydroelectric or thermal power stations seems advantageous in cases where large fluctuations in peak load are anticipated.

I cannot overemphasize, of course, that these comparisons are based on assumptions regarding the capital cost of the nuclear plant, its fuel and inventory costs, its operating and maintenance costs, and its plant life. None of these assumptions have yet been proved in commercial practice, though informed opinion considers them reasonably realistic.

Bearing in mind these general guideposts of nuclear-power economics, we can take a closer look at the potential markets.

In the group of mature industrial economies—principally the United States and Western Europe—we note the assurance of continued high rates of capital formation and growth of productivity. Both factors are conducive to the introduction of nuclear power, but driving forces of economic motivation differentiate the United States from other countries in this group.

America's relatively greater reserves of coal, oil, and gas, available at low cost, lessen the economic incentive for immediate domestic utilization of nuclear power. With the price of coal at around $8 per ton or less in most industrial centers, it is evident that nuclear plants cannot yet hope to compete with conventional ones—let alone pay out any returns on investment. It is likely to be another decade at least, I believe, before we can expect nuclear plants to be installed in this country for reasons of commercial profitability alone. The next 10 years could be lean years profitwise—for the American nuclear-equipment industry. This lack of financial incentives was cited as a major roadblock toward atomic progress by over 30 percent of some 170 companies recently polled by the Atomic Industrial Forum. It is my strong impression that it is the most important single industrywide retarding factor.

The picture abroad is very different. The price of indigenous fuel in Western Europe ranges from $10 per ton upward, and local supplies are insufficient to meet demand. Imported supplies cost as much as $20 per ton of coal or its equivalent. Within the next 10 years, Europe's energy needs will exceed indigenous production by more than 40 percent—double the gap today. Most of this gap must be filled by greater imports of conventional fuels, mainly oil and some coal. The Suez dilemma though, all else aside, is a dramatic reminder of the precarious position of Europe's major fuel imports. Alternative supplies from the Western Hemisphere could be as scarce as dollars are to pay for them. Europe must become self-sufficient in energy resources. Atomic power, therefore, is regarded as the hope for Europe. Only last December, Britain raised her aim for projected nuclear powerplants by 2 to 3 times over estimates made only 6 months earlier. Total installed capacity of around 5 million kilowatts is now planned for 1965.

Closely parallel thinking is found throughout most of Europe, though technological progress is not yet as far advanced as in Britain. To accelerate

progress, various types of regional pooling of resources are under discussion. Euratom is expected to be created sometime next month. Three representatives of this organization who visited you here in Washington a few weeks ago, sought not money but American technical information and atomic fuel. Their assignment of determining how fast and how big a network of nuclear powerplants can be created in Europe has resulted in tentative aims set at 3 million kilowatts by 1962 and 15 million kilowatts by 1967.

To repeat, lack of indigenous fuel and high-cost imports are urgent motivations toward nuclear power in most mature industrial economies other than the United States. Moreover, their financial equation for competitive nuclear power does not, unlike ours, rest only on a straight comparison of total costs for nuclear as against conventional plants. In some cases, foreign-exchange quotas exert a further powerful leverage, in that a prolonged and increasing demand for foreign fossil fuels will aggravate an unfavorable balance-of-payments position. A premium of present-day higher capital costs for nuclear plants might therefore be acceptable in view of long-term financial savings through lesser fuel imports.

Japan, for instance, now spends about one-third of all her dollar and sterling credits—clearly a disproportionately large sum of vital foreign currency—for costly fuel imports. This one example, typical of many others, is indicative of the industrial inertia and consequently lessened chances for improving living standards that are caused by high fuel costs. (In 1952 the average Japanese consumed energy equivalent to 1.1 metric tons of coal and earned the equivalent of 165 United States dollars; for the average Briton it was 4.6 tons of coal and $715; for the average American, 8.2 tons and $1,857.)

To all these economic pressures, then, atomic power offers some hope of ultimate relief. Within the next decade, the market for nuclear power in Europe and Japan might well amount to 15 million kilowatts, as compared with some 2.3 million kilowatts likely to be built in the United States for purposes of long-range technological development of economical domestic plants. Moreover, this foreign market calls for large-size power units to supply base loads. As I said earlier, American technology should be capable of building such nuclear plants within the next few years to provide power at prices that are attractive on the European market.

There are two important factors, though, that America must bear in mind:

The first is positive; that is to say, the European market does offer a competitive proving ground for our nuclear goods and services and provides immediate financial incentives for our industry, provided that,

Secondly, we recognize Europe's clearly stated aim to become self-sufficient, as soon as possible, in the manufacture of nuclear reactors and fuels.

In other words, I believe it essential to consider the European market for nuclear power as a partnership enterprise between American and European manufacturers. Any thought, on our part, of exporting complete plants and providing ancillary services over an extended period of time would seem unrealistic. Some will be sold, undoubtedly, since speed is of the essence, but in the longer run Europe has the technical capabilities of manufacturing the equipment; it lacks the know-how to do so at once. Europe has the need; American industry has the know-how. We should seek to capitalize on it, and I urge that equity arrangements, such as nuclear manufacturing plants located abroad and jointly owned by American and foreign interest, be considered immediately. Licenses are an additional source of revenue, though I understand—and I say this with some trepidation, not being a lawyer—that the patent provisions of our Atomic Energy Act leaves something to be desired in this respect, at least as seen from the profit-motivated viewpoint of industry.

In the availability of nuclear fuel, we run up against a problem that requires careful consideration lest it prove a serious stumbling block to American-European cooperation. Our prototype reactors in this country are fueled with enriched uranium which have seemed to use the more promising types to develop—for the long-range domestic market. Europe, on the other hand, has no fuel-enrichment facilities as yet. Even Britain, with such facilities—limited in availability, though, by weapons requirements—is going the way of building natural-uranium-fueled powerplants. The economics of these plants, though anticipated to be inferior to enriched-uranium types over the long run, are still adequate for Britain's immediately foreseeable needs. Some of her European neighbors seem inclined to think likewise in regard to their own situation.

Proponents of enriched-uranium fuel who are clamoring for the communal building of an enrichment plant in Europe are countered by arguments that

the future availability of plutonium from natural-uranium reactors will permit fuel enrichment to be carried out when it becomes economically necessary. "Therefore let us build natural-uranium reactors first" is the suggestion that seems to be winning some favor in European eyes. For in spite of President Eisenhower's offer of considerable amounts of enriched fuel for foreign consumption, there is a strong feeling in Europe and elsewhere that such complete dependence, even temporarily, on American supplies would be unhealthy. One might hope, though, that international political developments, such as the establishment of the International Atomic Energy Agency, the emergence of euratom, as well as other cooperative nuclear ventures sponsored in Europe by the Organization for European Economic Cooperation, and the more liberal interpretation of bilaterial treaties, will soon progress to the point where some of these seemingly intangible considerations will cease to be major obstacles to trade in enriched uranium.

If Europe should then feel free to choose enriched fuel, American industry is all set to trade. Even in the natural-uranium field we have a good deal to contribute. Indeed, AEC's most recent invitation to United States industry for bids on recator development gives top priority to natural-uranium types. Now, should it not be possible for United States companies to undertake such developments jointly with some European or Japanese companies and for such plants to be sold in places where they would now pay their way, namely, abroad? It is obvious enough that such a proposal is beset with difficulties of all kinds: Security considerations, international legal matters, and insurance liabilities are critical examples. But I do suggest that very serious consideration should be given to this proposal, and I believe that ways can be found to solve the problems. Of this I am certain: the effort is indisputably worth making from American industry's point of view. And from a foreign-policy aspect, I can think of few more dramatic and practical ways to implement our principles. Considering our friends abroad as working partners—each of us entitled to his share of profits—rather than as recipients of technical aid, grants, and the like, would give real meaning to "atoms for peace."

So much for Europe and the other mature idustrialized countries. What of the intermediate group, where the pace of industrialization is quickening—countries in Latin America, such as Brazil, Bolivia, and Argentina, and some areas in Asia, notably parts of India? The rate of increase of energy consumption tends to be higher in this group than in either of the other two. But these regions possess neither the technology nor the resources to build their own powerplants. Also, domestic capital formation is likely to be inadequate in all but very few exceptions for the financing of any major power scheme. All of this spells almost complete dependence on foreign imports and investment.

Experience indicates that powerplants, other than hydroelectric, are required in the range of 1,000- to 10,000-kilowatt capacity units. This suggests that reactors of small size, using enriched fuel are needed. In other words, this market is clearly one for the export of complete nuclear plants of a kind that United States industry is now uniquely qualified to construct. The 10,000-kilowatt nuclear plants slated by American and Foreign Power for three Latin American countries are typical examples of such exports.

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Estimates for the whole group of industrializing countries indicate a potential for about 1,500,000 kilowatts of installed nuclear power during the next 10 years. (Also included in this figure are some of the smaller-size nuclear units that might be used in the underdeveloped countries, and—indeed—the mature economies as well. Woodpulp mills in Scandinavia and northern Canada, for instance, offer possibilities for such nuclear plants to generate process steam.)

All in all, the nuclear package power concept has much to commend it as a world-trade commodity. Infrequency of refueling would enable it to economically open up the new raw-material resources upon which the world's future industrial growth will so largely depend. The size of the market apparent even today suggests that sufficient package units are needed to permit some degree of standardization and, therefore, mass production. Consequent economy of manufacture could well bring the cost of nuclear power down to attractive levels. Here again, partnership arrangements between American and foreign reactor builders could assure a long-term stake in these markets. Though our industry might capture the market now—because of our lead in enriched-uranium reactors—we would ultimately lose a very substantial portion to the less expensive foreign manufacturer who has been a major traditional supplier of powerplants for this market.

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Europe and Japan	10
Industrializing and underdeveloped countries	1.5

It would seem reasonable to expect American industry to get, say, 35 to 40 percent of the revenues derived from foreign markets for nuclear-power equipment, its share being equivalent to about 6 million kilowatts of installed capacity during the next 10 years. Contrasting this with the domestic market, during the same period, of about 2.5 million kilowatts, we recognize the importance of worldwide trade to the American nuclear industry in its growth to commercial profitability.

The CHAIRMAN. The committee is adjourned until 2 o'clock in this room.

(Thereupon, at 12:10 p. m., the Joint Committee recessed, to reconvene at 2 p. m., the same day.)

AFTERNOON SESSION

The CHAIRMAN. The committee will come to order.

This afternoon is a continuation of the hearing on section 202. This afternoon we have Mr. R. A. Brightsen, president of the Nuclear Science & Engineering Corp., of Pittsburgh, Pa.

STATEMENT OF R. A. BRIGHTSEN, PRESIDENT OF NUCLEAR SCIENCE & ENGINEERING CORP., PITTSBURGH, PA.

Mr. BRIGHTSEN. Mr. Chairman, I am R. A. Brightsen, president of Nuclear Science & Engineering Corp. (NSEC) of Pittsburgh. My experience in the atomic-energy field dates back to early 1945 when I was employed as an analytical chemist at Oak Ridge. In 1948 I participated in Project Sandstone, the atomic weapons tests in the South Pacific as a radiochemist with Tracerlab. From 1950 to 1954 I was a senior scientist in radiochemistry at the Westinghouse atomic-power division, where I participated in the solution of some of the radiochemical problems associated with the development and operation of the *Nautilus*.

Our company was organized almost simultaneously with the passage of the Atomic Energy Act of 1954, and largely due to its almost singular nature, has grown in 30 months from a full-time staff of 5 to a present staff of 35. This clearly classifies our company as a very

small business. Let me hasten to add, however, that the nature of our business, the caliber of our staff, and, above all, the experience and wisdom of many of our directors, lends considerable credence to our anticipated rapid growth in the years just ahead. Since our inception, we have been most fortunate in having the active guidance of Gordon Dean, who has participated as chairman of our board of directors, as well as such notable figures in the world of atomic energy as Glenn T. Seaborg, Manson Benedict, Charles Coryell, and Truman Kohman, all of whom are directors of the company.

At this point I should like to briefly outline the subject matter to be covered in this statement.

1. The general nature and functions of NSEC.
2. Specific examples of NSEC research, development, and services in reactor development and operation, industrial applications of nuclear techniques and special projects.
3. Some comments on AEC research and development policy.
4. Some comments on the problems of waste disposal.

It is my hope that I can contribute in some small way to the accelerated development of the peaceful uses of atomic energy by—

(1) bringing to your attention the effective role that a small business can assume, in research, development, and service activities.

(2) commenting on AEC policies on research and development in the reactor field and in the important field of industrial applications of nuclear techniques, and

(3) commenting on a major problem of concern to all of us who are in the atomic-energy business—the disposal of radioactive wastes.

THE GENERAL NATURE AND FUNCTIONS OF NSEC

Our corporate purpose has been, and still is, most unusual. We function as an experimental research, development and service organization, specializing in the problems and applications of radioactivity, a phenomenon which can be truly characterized as a common denominator of the atomic-energy field. We do not manufacture radiation detection equipment, and we do not design or build reactors. Our corporate purpose, the stature of our directors, and the equity incentives we have been able to offer have enabled us to attract and maintain on our staff scientists and engineers of outstanding caliber and extensive experience, covering almost all the areas of science and engineering: chemistry, biology and medicine, engineering, and physics. Within this indicated framework, we consider our market to be twofold in basic character:

1. Organizations or groups engaged in reactor development or operation.
2. Companies interested in applications of nuclear techniques for process control, new product development, and so forth.

With respect to the reactor field, it is, I think, important to note that we did not organize NSEC with the presumptuous thought of providing research, development, and services for the Government. Rather we were motivated by the thought that the Government's superb national laboratories would be in the main dedicated, in the

reactor field, to research and development on advanced reactor types, and that there would be relatively little capacity available to solve the problems that privately sponsored reactor programs would inevitably encounter.

Thus we anticipated the emergence of a need for specialized research, development and service capability; further we expected that there wouud be some reluctance on the part of private industry to invest their own capital in the specialized facilities and scarce manpower required to solve problems that appear to be more or less incidental to the main objective: designing, engineering, constructing and operating a nuclear powerplant at the lowest possible cost.

We concluded that, in view of the basic attitudes toward private participation in atomic energy, if we could organize a company with adequate facilities and high-caliber experienced scientists we would have a very salable product: talent. Our limited experience, acquired during the past 2½ years, indicates that this thesis is sound. The demand is developing, and contracts are materializing.

Of course, the analysis I have just presented is not quite so clear-cut, and many gray areas are visible. For example, the degree of Government participation in power reactor programs covers the entire spectrum of percentages, and it is expected to change as time goes on. Similar observations can be made on other statements made above, but these do not alter the basic observations.

Prior to submitting for your consideration some comments on AEC research and development policy and waste disposal I should like to clarify the nature of our work by summarizing for you the kinds of projects we have done or are doing. For this purpose our activities are conveniently divided into three major categories: (*a*) The reactor field, (*b*) the field of industrial applications, and (*c*) special projects.

I have pointed out that we do not design or build reactors. During the development phase of a reactor type, however, many questions arise which can only be answered by developing reliable experimental data. In this connection, NSEC has conducted hundreds of radiochemical analyses on prototype fuel elements, coolant water, ion-exchange resins and components materials for the pressurized water reactor. We have helped particularly with research and development on certain phases of PWR fuel elements and fuel materials programs. We also had a role in the research on fuel element rupture detection systems and in decontamination practices.

Similarly, in design of the Pennsylvania advanced reactor, which is ,as you know, a homogeneous reactor using as fuel a slurry of thorium and uranium oxides, the distribution of the fission products resulting from the chain reaction is a major question. Whether these fission products remain in solution or whether they remain with the slurry particles radically affects the design of the fuel decontaminating procedure. The research program on this problem is proceeding successfully, and developing data which will be of great value in firming final design specifications.

NSEC is also participating in the aircraft nuclear propulsion program. We are conducting radiochemical research and measurements on certain equipment which will be used in conjunction with the reactor.

Another aspect of the reactor program to which NSEC has contributed is in fuel element fabrication. Our contribution has been to help manufacturers who intend to fabricate fuel elements meet the AEC requirements on health physics, accountability, criticality, and, in some cases, security. This has involved the preparation of detailed procedure manuals for the fabricators in conformity with the requirements of the cognizant AEC area offices. As far as I am aware, NSEC is the only commercial organization which is actively rendering this kind of assistance.

Another example of NSEC's participation in reactor work is our operations with Duquesne Light Co. In a short time Duquesne will have responsibility for operating the Shippingport power reactor. There are many problems of procedures, chemistry, and laboratory practices for which they need solutions. We are assisting them with radiochemical and health physics procedure manuals, monitoring practices and equipment recommendations. Our basic function is to recommend practices that will, in time, effect some reductions in operating costs.

The second major field of interest to NSEC is that of applications of radioactivity. I shall give only two examples. The most interesting is a large-scale tracing experiment for a major oil company. A common practice in present-day oil technology is to "pressurize" almost-depleted oilfields. That is, when production from a given field drops because of low gas pressure, the lagging wells frequently can be made to produce more oil by forcing natural gas into central "injection" wells and forcing more oil out of peripheral "producer" wells. But the movement of these pressurizing gases in the ground is not known, the holdup time is not known, and channeling from injection well to producer well may exist. These and many other geological questions may be answered by the kind of tracer experiment which is underway at the present time. Several months ago NSEC added radioactive methane and radioactive krypton to the pressurizing gases. Since then we have been analyzing gases collected from the peripheral wells for their radioactive methane and krypton content. The results of this experiment may well change some of the economics of pressurizing oilfields.

The second industrial application illustrating my company's interests which I want to mention is still in the research stage. In the manufacture of silicon metal for transistor applications great effort is exerted to produce the metal in a fantastically high purity. Certain elements, in concentrations of less than parts per million, confer undesirable properties on the final product. One of the worse offenders in this respect is the element boron, but unfortunately, there is no known chemical method for determination of these infinitesimal quantities of boron.

The Air Force has given NSEC a contract to develop a method for determining boron in silicon by a nuclear technique. It involves cyclotron irradiation of silicon samples and investigation of the resulting radioactivity which then gives a measure of the boron concentration. Having a satisfactory analytical method will shorten considerably the time necessary to prove out manufacturing and fabrication techniques for ultrapure silicon.

There are many programs of interest to NSEC which can be classified under neither of the above categories. I have called them

special projects for purposes of illustrating the corporate interests of NSEC. A few of these will be of interest to you.

The first major project undertaken by NSEC after its formation was analytical work for AEC's Project Sunshine. This, as you know, is the long-range program initiated by Commissioner Libby to determine the extent and rate of fallout from bomb debris. Our radiochemists analyze biological samples and rainwater samples for strontium-90, as you know, the most hazardous of the fission products. NSEC is one of the few commercial laboratories staffed and equipped with the highly specialized instrumentation required for such work. To date we have analyzed about 1,200 such samples for strontium-90. Thus, a good fraction of the data forming the basis for AEC fallout information has come from our laboratory.

A second major effort at NSEC is in biology. Some of our radiobiologists have discovered that increased lethality from irridiation is apparently produced by a factor or factors in the body, and that this factor can be transmitted from an irradiated animal to an unirradiated animal via blood serum. This is to say that unirradiated animals, when given blood serum from irradiated animals show a higher lethality rate than controls. Scientifically and practically, this discovery is extremely important. If we succeed in isolating the toxic factor, we can study it, and if we can study it, we may be able to find an antidote. We of NSEC think this program is so important that, as small as our company is and even though we have only recently become a profitable organization, we have been matching AEC dollars with our own since 1955 to pursue the study.

Another study we are conducting concerns the disposal of high-level radioactive wastes from the processing of fuel elements from reactors. I will have more to say about this a bit later. Suffice it to say here that the waste disposal problem seems certain to become more serious in the future. And in this study, on a no-cost-to-the-Government contract, NSEC has undertaken the task of preparing a definitive document reconciling the sometimes contradictory literature and detailing practices at the various sites.

NSEC is conducting many other interesting, and we think, important studies and services. For the Quartermaster Food and Container Institute we are undertaking the determination of the quantity of radioactivity induced in foodstuffs by irradiation devices which may be used for preservation purposes. For Resources for the Future, Inc., we are going to study the errors which might arise in the use of tritium as a ground-water tracer. This tracer application is one suggested by Commissioner Libby for use especially in studying the water resources of the Midwest. We process and distribute most of the commercial cyclotron-produced isotopes in the United States. We are probably the only company in the United States which performs urinalyses for uranium required on workmen in uranium processing and fuel element fabricating installations.

SOME COMMENTS ON AEC RESEARCH AND DEVELOPMENT POLICY

The Atomic Energy Commission has for many years pursued a wise and farsighted policy in supporting an extensive research program in the physical and biological sciences largely through the Division of Research and the Division of Biology and Medicine. Such

research has been rather basic in character, and has mainly been conducted at the AEC National Laboratories or universities. This research appears to be only incidentally related to the solution of problems common to all or many reactor projects.

Most of the research and development the AEC is doing on these latter problems seems to be supported by the Division of Reactor Development, and is generally tied to a specific project and conducted at AEC laboratories or prime contractor's sites. We should like to suggest that an additional approach be considered, designed to encourage private companies to participate in the solution of this type of reactor problem without associating the work with any specific reactor project. That is to say, perhaps the AEC can devise a mechanism for inducing private enterprise to undertake such research and development, using their own facilities and manpower, and perhaps partially supporting the program, in return for patent protection, or other economic incentives. It is clear that many variations on this theme can be conceived, and it is not my intent to pose a definite solution. It does seem reasonably certain that some such approach might be very effective in harnessing industrial research and development effort on these common reactor problems.

By way of illustration, permit me to summarize just a few of these common problems very briefly.

1. Fission product cross sections: Fuel reactivity changes due to accumulation of long-lived and stable fission products will become important limiting factors in core lifetime in many power reactors. Adequate cross section data on fission products are not available; hence accurate forecasts of performance and economics become impossible.

2. Neutron flux monitors: Almost any power reactor program has need at some point in fuel development and performance evaluations for improved methods of neutron flux measurement. Research in this area is badly needed, especially to develop more refined methods of measuring neutron fluxes in various neutron energy ranges.

3. Waste disposal: It is apparent that the disposal of radioactive wastes is related most directly to fuel reprocessing, but to a greater or lesser degree all atomic energy installations will face this problem. Private chemical research and development capability might be brought to bear on developing new and safer approaches to waste disposal.

We should also like to suggest that AEC continue its enlightened policy of utilizing the National Laboratories for fundamental and long-range research, both in basic science and the development of advanced reactor types.

With respect to providing research, development and service assistance under the power demonstration reactor programs we would hope that the AEC would undertake this work in their own facilities only when it is clear that private industry cannot or will not undertake it, even though the funds be largely or altogether supplied by the AEC. More fundamentally, we believe it is in the interest of the Nation to take effective steps to encourage widespread participation by industrial research and development talent in the solution of reactor problems.

Finally we would like to observe, on the basis of our experience, that rapid exploitation by industry of nuclear techniques is not being achieved. This is in part due to lack of understanding on the part of industry, but more importantly due to high initial development costs which cannot be justified from a single corporation's point of view. We should like to suggest that the AEC consider an industrial applications program whereby the AEC would partially subsidize development programs submitted by an industrial organization.

SOME COMMENTS ON PROBLEMS OF WASTE DISPOSAL

I have previously indicated that our company has been conducting a survey for the Atomic Energy Commission on the disposal of high level radioactive wastes. This survey is nearing completion and will become available to industry through the AEC sometime this summer. It seems only appropriate to pass on some opinions that we have developed regarding the status and future of waste disposal.

Basically, it appears that disposal of radioactive wastes is a problem, not from an economic standpoint but from a biological hazard standpoint. This simple thought seems to become submerged in the deluge of words that are spoken on waste disposal. The state of the art is such that storage of radioactive wastes appears to be adequate from a practical standpoint and will not contribute substantially to the cost of nuclear power. Indeed there are no other solutions on the horizon which can be rapidly brought into large-scale use. It is true that other methods may be developed which may be safer over a longer time period from the radiological standpoint and may be incidentally less expensive than the storage approach.

If these conclusions are valid, as they appear to be to us, then the motivation for increased research and development effort can only be to develop techniques which will be more safe and only incidentally less expensive. The entire question of more safe is almost impossible of definition for indeed there are considerable data lacking on the biological hazards of many of the fission products. It seems to us that the Government must in the last analysis assume long-term responsibility for radioactive wastes, for the lifetime of some of the species produced in fission which are potentially hazardous far exceed the anticipated lifetime of any corporate entity.

We think that the waste-disposal problem should be attacked from two points of view:

1. Whereas the present technique is satisfactory, it is not necessarily the best technique nor the cheapest, and consequently research efforts toward developing better methods of waste disposal should be continued. The emphasis should be toward better methods from a biological hazards point of view rather than an economic point of view.
2. Concurrently, expanded effort should be instituted to evaluate the biological hazards of radioactive species. The end result of such research would be clearer definitions of biological tolerance levels for the many types of radioactive nuclides that will be produced in an expanding atomic-energy industry.

In closing I should like to express my sincere appreciation for the opportunity to present to you some of our views on the atomic-energy program. These opinions and recommendations we hope will con-

tribute in some measure toward a continuing vigorous partnership between the Government and industry.

The CHAIRMAN. Thank you very much, Mr. Brightsen. That is a very interesting statement.

Mr. Holifield.

Mr. HOLIFIELD. Mr. Brightsen, I think you have brought a very challenging statement to us, particularly in waste-disposal problem which has not received as much attention as you are giving it. I seem to detect in your points 1 and 2 on page 12 that you are very definitely concerned with the biological hazards of waste products. What is that concern, and relate it, please, to the present methods of waste disposal.

Mr. BRIGHTSEN. The concern stems basically from the fact that there are a very large number of species produced in the fission process, many of which have a long lifetime. The biological tolerance levels for all of these species is not known, or at least is not recorded in the literature. I am sure it is just not known. We have run into the problem of tolerance levels of radioactivity in conducting industrial tracer experiments, as an example. There are some species which can be very useful in industrial tracer experiments for which no data are available at all. This puts all the authorities concerned in a very difficult position. One just doesn't know how much one can safely use.

The entire field of biological hazards of radiation, in my opinion, is one which deserves considerably more attention than it has so far gotten in the program.

Representative HOLIFIELD. I happen to feel that way also. I know this recent study that was put out on the Marshallese people by the Naval Laboratory and some other groups that have been studying it and I see that they now come up with a suggestion that possibly the lethal dose of accumulative radiation should be lowered from what has heretofore been announced as 450 roentgens to 350 roentgens. This apparently is as a result of increased knowledge as to the lingering effects upon people and also the lingering residual radioactivity on these islands. That is quite a startling change, to change from a lethal-does level by 25 percent, and suggesting that the accumulative level be reduced 25 percent.

I suppose you are familiar with that study that has been recently released?

Mr. BRIGHTSEN. I do not think I have read that, Congressman.

Representative HOLIFIELD. The point you are bringing up indicates that even in this field where most of the study has been made, which has to do with the explosions in the South Pacific, they are coming up with new information. What you say here in effect is that there are many of these radioactive nuclides which have a completely unknown effect. That is, we have no data on it. We have no criteria of exposure.

Mr. BRIGHTSEN. This is certainly right.

Representative HOLIFIELD. It seems to me that before we start turning this material loose for industrial users and other efforts, that the point of caution would be to explore a little bit more thoroughly into this field.

Mr. BRIGHTSEN. Yes. I do hope the point is made clear that when the statement is made that the waste-disposal problem is essentially a biological-hazards problem it is not made in the sense that it is an

external-exposure problem to people. It is a basic question, I think, of ingestion of radio radioactivity, and not a question of exposure.

Representative HOLIFIELD. Ultimately ingestion.

Mr. BRIGHTSEN. Yes.

Representative HOLIFIELD. I understand that.

Mr. BRIGHTSEN. Yes.

Representative HOLIFIELD. In other words, at the present time where we are putting this waste material in very heavy concrete vats, let us say, and putting them in the ground somewhere and we are exercising, I assume, due caution and placing where they will not contaminate underground water streams and so forth, you are looking forward into the future where those vats may be the very process of age dissolve and these very long-lived radioactive nuclides will be released from their prison and get into the underground environment in some way?

Mr. BRIGHTSEN. There is, of course, the suggested possibility that appears to be practical that one simply transfer radioactive materials from one tank to another as the lifetime of tank one gives out, for example. This would presumably alleviate any problem of dispersal of the activity to the surroundings.

Representative HOLIFIELD. But this again is in terms of decades.

Mr. BRIGHTSEN. Many years.

Representative HOLIFIELD. 50, 75, 100 years. This would be much more expensive, would it not, than the present process of putting this material in tanks and putting it underground?

Mr. BRIGHTSEN. It would be simply transferring it to a new tank when the first tank wears out.

Representative HOLIFIELD. We had the case, I think, in one of the Sunday supplement magazines of the man who accidentally got hold of some radioactive isotope material that was used in the detection of flaws in steel and he put it in his pocket and carried it around for a day or two, and then he put it in the glove compartment of his car. This was also referred to by one of our witnesses. It seems to me that if this dangerous material is now being released without proper safeguards and proper criteria and responsibility to handle these materials where an accident like this could occur with a relatively little use we have of this, we are facing a tremendous problem in America where in the place of a few thousand industries we have 50,000 industries using these materials for measurements, all of them having a very definite biological hazard, which in many instances has not been ascertained as yet.

Mr. BRIGHTSEN. The problem has some validity in the reverse as well. In many cases, one has to be extremely and perhaps overly cautious because many of these species may turn out to be relatively harmless. However, one cannot make this assumption.

Representative HOLIFIELD. The point you are making now is that there is a very limited knowledge in the field and that there should be a great deal more, and you believe further that companies like yourself could undertake research and development contracts which would further the accumulated knowledge in this field?

Mr. BRIGHTSEN. It would be my thought that, basically, this kind of work ought to be done at the national laboratories and not by private industry. Our point here is simply that expansion of research on biological hazards of radioactive species certainly seems to be in order

from the waste-disposal point of view as well as from the point of view of increased industrial utilization of radioisotopes.

Representative HOLIFIELD. Do you believe that the Federal Government can properly discharge its responsibility in the ownership and origination of this material by at any time in the foreseeable future losing control of the location and the use and the methods by which this radioactive material is used in industry? In other words, do you think we can turn it over to the States in the present state of knowledge and depend upon the State police powers to discharge this responsibility of environmental protection to the extent that it should be done?

Mr. BRIGHTSEN. Let me make this observation. I believe that keeping control over these radioactive wastes is exceedingly important. When I say "keeping control," I mean accessibility to get at what you have disposed of once you have disposed of it. Dispersing it to the atmosphere or into the ocean is an irreversible process. Once this is done you can no longer take it back. In view of the status of knowledge of biological hazards of radioisotopes, it would seem to me that the wise approach would be to pursue waste-disposal techniques which leave the radioactivity in control of an organization, whether this organization is the Federal Government or the State government. That latter is an altogether different question.

Representative HOLIFIELD. Just like we have been doing all the time.

Mr. BRIGHTSEN. Yes.

Representative HOLIFIELD. But, as we have more industrial use, there is going to be a considerable increase in the accumulation of waste; is there not?

Mr. BRIGHTSEN. Yes, sir.

Representative HOLIFIELD. The thing I would like to ask is this: Do you think that, with the present knowledge of the hazard involved, the Federal Government is in a position at this time to abdicate its primary responsibility to protect the people from this hazard and turn it over to the States at this time?

Mr. BRIGHTSEN. I think it would be more desirable that the Federal Government keep control of this, simply because it would be so very difficult for the States to administer a uniform policy effectively.

Representative HOLIFIELD. Let us leave the waste for a moment and go to the uses of quite large concentrates of material for detection purposes and measuring devices, such as is now being used industrially. What about the Federal Government's responsibility for the hazard there, taking into consideration the fact that most of these operations are under State health-protection laws of different kinds? Yet here is the one new factor being introduced into it. I am not advocating that the Federal Government do this. I am just inquiring from you as a person concerned with this problem how we are going to discharge our Federal responsibility in seeing that these materials are handled properly and not handled to the detriment of people in the environment in which they are used.

Mr. BRIGHTSEN. I might make this point. It seems to me that it might be logical for the Government to assume responsibility for these type of materials up to the point at which a private company assumes that responsibility and the Government is satisfied that the

regulations which are promulgated to protect the health of the people in the plant are adequate. The corporation ought then to assume responsibility for its proper use.

Representative HOLIFIELD. I was somewhat alarmed when I read about this specific case, and I assume it is a documented case because it has been referred to by responsible people, where one of these radioactive cartridges was so carelessly watched or cared for. It was attached, as I understand it, by a string and put in a crevice in the wall for safekeeping. He took it off the string and put it in his pocket and carried it around for several hours, at least, and then put it in the glove compartment of his car and finally, 3 or 4 days later, they find where this cartridge is located.

After putting out an alarm and searching a lot of cars and that sort of thing, they found it. Someone was careless to begin with. I do not know who it was. They are dealing with a lethal material which is just the same as a loaded gun, you might say, and even more dangerous than a loaded gun because it is nonrecognizable.

Mr. BRIGHTSEN. Yes.

The CHAIRMAN. Mr. Cole.

Representative COLE. I am not sure whether Mr. Brightsen can help me in my problem, because I am not sure I know what the problem is. I have difficulty in visualizing what is conceived in the expression "research and development." I think I know what research is and I think I know what development is. Tell me, if you can, when does a problem cease the realm of research and enter the realm of development?

Mr. BRIGHTSEN. I wish I could remember Professor Seaborg's answer to that.

Representative COLE. Give me Brightsen's formula.

Mr. BRIGHTSEN. It would seem to me that a simple line of demarcation between research and development would be the point at which one can see application ahead and one is attempting to determine whether the application is feasible. At that point, I think, you are doing development work. I think when you are simply investigating phenomena for the sake of determining what rules govern interactions of matter it is research. I am sure there are many people who would disagree with this definition.

Representative COLE. I appreciate it cannot be simplified.

The CHAIRMAN. This is a rather simple statement that I heard once. You are in the research state when you put two chemicals together. When you take them out of the glass and do something else you are in the development stage. This is rather simple.

Representative COLE. Is it not also in the development stage when you take that product out of the glass and discover it is something else and you put it to work?

Mr. BRIGHTSEN. Yes.

Representative COLE. Is that not also development?

Mr. BRIGHTSEN. Yes.

Representative COLE. Since you say your group is not in the reactor fiield you probably are not ready to answer, but it seems to me that it is as much a part of development to install in a fuel reactor the pipes, material, metal—what is referred to as the bricks and mortar—which have been the consequence of the preceding efforts in resarch.

The practical, actual application of those lessons, in my conception, is as much a part of the developmental problem as what is done in the laboratories. Is that unreasonable?

Mr. BRIGHTSEN. That is a fair analysis, I think.

Representative COLE. Therefore, since the Commission does have a policy of giving substantial assistance in what we have thrown together as research and development, but has refused to extend that participation to the actual construction of those parts of the entire project which are directly related to the research effort, it occurs to me is not shortsighted, but they have only gone halfway. Maybe more than half, but they have not gone the whole way in proving out the lessons that have been learned in the laboratory. Since you are not in the reactor field, I excuse you from answering, unless you want to.

Mr. BRIGHTSEN. I do not think I can add anything.

Representative COLE. The trouble with the Gore-Holifield bill is that it not only builds the consequences in the laboratory but also the concrete which people have learned how to build for centuries. If you would limit the Gore-Holifield bill to the new concepts that go into the reactor, that would be something else. But you put in the concrete, too. This is just between Mr. Holifield and myself, and you need not answer.

Representative PRICE. Mr. Brightsen, you state you are participating in the aircraft nuclear propulsion program. Is your work being done with all the contractors in the program or with one particular one?

Mr. BRIGHTSEN. At the moment, a particular one.

Representative PRICE. Which program are you associated with?

Mr. BRIGHTSEN. General Electric, at Cincinnati.

Representative PRICE. Do you know of any technical setbacks that might be the cause for the slowdown in that program?

Mr. BRIGHTSEN. I think in the broad sense of the question you are presenting I do not. I know of some technical problems.

Representative PRICE. But none that should cause a serious slowdown in the program?

Mr. BRIGHTSEN. I am not really that familiar with the project as a whole.

Representative PRICE. That is all I have, Mr. Chairman.

Representative PATTERSON. Mr. Brightsen, following up Mr. Price's query, there must be some technical slowdowns in the overall development for the simple reason that they claim they have now reached the point of saturation as far as the ability of the employees to continue the program and progress. They have to slow up for another year or so until they can take a look at the overall picture. Is that true?

Mr. BRIGHTSEN. As I pointed out to Congressman Price, the cognizance which we have over the ANP program as a whole is quite limited. So we are really not in a position to comment on how many or how serious are the technical problems the project faces.

Representative PATTERSON. I thought working on that, in accordance with your statement, you might know.

Mr. BRIGHTSEN. We are working on a phase of the program.

Representative PATTERSON. What phase?

Mr. BRIGHTSEN. I think it is classified.

Representative PATTERSON. That is all, Mr. Chairman.

The CHAIRMAN. Thank you very much for your unique contribution. I think you have something different from anyone we have heard from here.

Mr. BRIGHTSEN. Thank you very much.

The CHAIRMAN. The next witness is Mr. J. Raymond Dyer, attorney, St. Louis, Mo.

STATEMENT OF J. RAYMOND DYER, ST. LOUIS, MO.

Mr. DYER. Mr. Chairman, and members of the joint committee, my name is J. Raymond Dyer. I am a lawyer, with offices at 418 Olive Street, St. Louis, Mo. I have been interested in atomic law for a number of years, have had articles of mine published on the subject, and last year was chairman of the atomic energy committee of the Bar Association of St. Louis. I hold an AEC access permit and am a graduate of the Atomic Law Institute here in Washington.

The subject of atomic energy in industry is a very broad one, so I shall confine my remarks to just one phase—advertising. I believe in truth in advertising, particularly in the atomic field.

I own stock in nine private power companies: Baltimore Gas & Electric, Consumers Power, Dayton Power & Light, Idaho Power, Illinois Power, Indianapolis Power & Light, Pacific Gas & Electric, Public Service of Colorado, and Union Electric, in St. Louis, Mo.

Last June 13 an advertisement appeared in 37 newspapers scattered across the country, entitled "How America Will Keep Its Lead in Atomic-Electric Power." I have a copy here. There was a congressional hearing on that advertisement, before Congressman Clarence Cannon's subcommittee of his House Appropriations Committee, on June 29. Mr. Edward R. Dunning, vice president of N. W. Ayer & Son, Inc., the advertising agency that wrote the ad, testified. His counsel, Francis H. Scheetz, of Pepper, Bodine, Frick, Scheetz & Hamilton, a law firm in Philadelphia, was present. I have a copy of the proceedings here.

The published report of the proceedings shows that the ad was prepared at the instance of 120 private power companies, banded together as an advertising combine. A task force, they called themselves—America's Independent Electric Light and Power Companies. All but two of my companies, Illinois Power and Public Service of Colorado, were of that group.

The ad was false and deceptive, gentlemen, in its data, in its format, and in its recitals. Anyone who knows anything at all about our white peace atom program, and the progress we have made thereunder, would know that ad was false.

I protested the ad to the power companies participating in which I owned stock. Every single one of them justified the ad on the basis of the public power-private power issue. I have the correspondence here.

None of those who wrote me knew the facts about our atomic-reactor program, nor about the programs of the other countries named in the ad. Nor did they care whether the facts were untruthfully presented by the ad or not. All they wanted to do was defeat the Gore bill, which to my mind did not have anything to do with the

public power-private power issue at all. At least not as that bill was reported favorably out of this committee, 14 to 0.

Mr. Scheetz took the position in a letter to me that the ad in question did not violate any law. I have his letter here. I thought it did. Section 45 (a) of the Federal Trade Commission Act provides that "unfair or deceptive acts or practices in commerce, are declared unlawful."

I took the matter up with the FTC. They ruled that that section of the act covered only advertisements for the sale of commodities, and that, besides, their appropriations were insufficient to permit them fully to enforce the law. I have the correspondence here.

Then I took the matter up with the Securities and Exchange Commission, in conjunction with another false and deceptive ad about lobbying, inserted by the Union Electric Co. in the St. Louis Globe-Democrat and the St. Louis Post-Dispatch last November 18. I have a copy of that 2-page ad here.

The SEC ruled that it had no jurisdiction over ads unless they covered the purchase or sale of securities or were related to proxy rules. And, without making any investigation, they ruled that that November 18 false advertisement of the Union Electric Co. was not related to the proxy rules. I have that correspondence here.

I think the SEC erred in so finding, in that it conducted no investigation of its own, and ignored all the evidence I presented of the ad's relation to the proxy rules. But that is neither here nor there. The point I want to make is not that, but is as follows:

As a stockholder I proposed to the Union Electric Co., which is a Missouri corporation, a resolution under SEC rule X–14A–8, for action by the stockholders at the next annual stockholders' meeting, April 20. In effect, that resolution would bar false advertising by the company, and false communications by management to the stockholders, and would prevent the officers and directors of the company from spending any of the company's money for either of those purposes.

I included in my proposed resolution the bar against false communications to stockholders because Union Electric, on November 19 last, had sent reprints of the false November 18 ad about lobbying to all its 59,778 stockholders, along with a reprint of a false and deceptive editorial of the St. Louis Globe-Democrat, of November 17 last, entitled "The Union Electric Co. Situation." In his November 19 letter to the stockholders Mr. J. Wesley McAfee, president of Union Electric, said that the enclosed Globe editorial "states the case clearly."

The Globe editorial did not state the case clearly at all. It twisted the facts and warped the law. It was deceptive and false. The editorial of the St. Louis Post-Dispatch, on the same subject matter, which was published November 18, the same day as the ad, and which was entitled "Shady Business," did state the case clearly. But Mr. McAfee did not send that editorial to the stockholders. Only the Globe's.

Well, the management of the Union Electric protested my proposed stockholder resolution to the SEC. Its officers and directors evidently did not want to be barred from false advertising and false communications to stockholders, in the atomic field or any other field. I have the correspondence here.

This will surprise you, gentlemen. The SEC upheld the company's protest. It ruled that my proposal was not a proper subject for stockholder action under Missouri law. I think they were wrong there, and I have been practicing law in Missouri for quite a number of years. I was admitted to the Missouri bar in July 1927, nearly 30 years ago.

But what was more surprising to me, and I am a member of the Illinois and New York and United States Supreme Court bars as well, was that the SEC also ruled that my proposal for barring false advertising and false communications to stockholders, whether in the atomic field or any other field, was a matter of policy to be determined by the management in the ordinary conduct of the company's affairs.

You will find that hard to believe, gentlemen, but I assure you it is true. I have the letter of February 21, 1957, signed by Mr. Harvey A. Thorson, Assistant Director of the Division of Corporation Finance, of the SEC, file No. 1-2967, here. Mr. Thorson assigns as bases for his ruling "rule X-14A8 (c) (1) and (5)," which are as follows:

> (c) * * * the management may omit a proposal * * *
> (1) If the proposal as submitted is, under the laws of the issuer's domicile, not a proper subject for action by security holders; or * * *
> * * * * * * *
> (5) If the proposal consists of a recommendation or request that the management take action with respect to a matter relating to the conduct of the ordinary business operations of the issuer.

I do not think that false advertising and false communications to stockholders are matters "relating to the conduct of the ordinary business operations of the issuer." But that is what the SEC has ruled. Of course I have protested. But it is very difficult to get a Government bureau to back up once it has taken a stand.

Hence, my suggestion to this joint committee is that it implement Federal legislation barring false advertising and false communications to stockholders in the atomic field. If you do so, gentlemen, I believe that legislation will be broadened to cover other fields. Just this month, February 4 to be exact, in reply to a letter of mine about this Union Electric situation, Representative Clarence Cannon, the venerable Missouri statesman who heads the House Appropriations Committee, wrote me:

> You touch on one of the crying needs of the time—truth in advertising. Vast sums of money are being spent to mislead the American people.

The CHAIRMAN. *Thank you very much.*

Are there any questions? If not, thank you very much for your statement, sir.

Senator GORE. That is a very interesting statement, sir.

The CHAIRMAN. Have you a statement that you care to make, Miss *Dyer?*

Miss DYER. Yes; I do.

The CHAIRMAN. *You may proceed.*

STATEMENT OF NANCY CORINNE DYER, ST. LOUIS, MO.

Miss DYER. My name is Nancy Corinne Dyer. I am a student at Bryn Mawr College, Bryn Mawr, Pa. My home address is 4503 McPherson Avenue, St. Louis, Mo. I do not know a great deal about the atom, or about atomic law, but I own 100 shares of Union Electric common stock that my father bought for me last spring, and because

of that I have taken an interest in the development of atomic power. The Union Electric Co., a Missouri corporation located in St. Louis, is one of a group of private power companies that is seeking to develop an atomic-electric power reactor near Chicago, Ill.

I am familiar with the private power companies' advertisement of last June 13, that my father spoke about. And, because Union Electric was one of the power companies responsible for that ad, I naturally did not like it. Like my father, I was in favor of the Gore bill, and I hated to see it defeated, as it was last July, by such unfair means. So I asked my father to protest the ad to Union Electric, on my behalf. He did, and he has the correspondence here.

Later on, when I received my copy of the Union Electric's letter of November 19, 1956, to all its 59,778 stockholders, I was again disturbed. It was false, and my father will tell you how and why. Since the company asked for comments I had my father comment, and he did, on my behalf. The letter contained a reprint of the Union Electric's false advertisement about lobbying that my father has already told you about.

Well, the company would not do anything about my protests, so my father and I decided to tell the stockholders why the atomic ad, and the lobbying ad, and the company's letter to the stockholders, were all false. I believe in stockholder responsibility, which I will touch on later. If the management of a company in which you own stock does bad things I think it is up to you as a stockholder to try to correct them, rather than sell your stock, as many people do. You have a cat and you take care of it. Why not your corporation?

Well, before we could tell the stockholders we had to get the stocklist. And Union Electric would not give it to my father, even though he presented them with my power of attorney, naming him as my attorney for that purpose. They said that because I was a minor, not yet 21 years old, I did not have the legal capacity to appoint an attorney. So I had to have my father file a lawsuit against the company on my behalf. In Missouri, you do that, if you are a minor over 14, by asking the court to appoint someone your prochein ami, or next friend. My father was appointed my next friend.

In its answer filed in the lawsuit the company admitted it had paid $1,500 as its share of the cost of that false atomic power ad of June 13, and that the November 18 lobby ads cost $6,600. That was stockholders' *money, of course. I didn't like that. I have a signed copy* of that answer here.

I lost the lawsuit. I think the lower court erred. The case is on appeal.

However, I got home the night before the trial, from college. That was *December 20. So the next day, before the trial, I asked the Union* Electric secretary, myself, if I might examine and copy the stocklist. *He put me off, but later that day, after the trial, he said I might.* There were some delays, of course, but after Christmas I finally was allowed to get started. I microfilmed the stock cards, with the help of a microfilm machine operator.

However, I was unable to finish the job before it was time for me to go back to college; 59,778 cards are a lot of cards. When I left I had some 15,000 more cards to do. Not until 2 weeks thereafter was my father, who in the meanwhile had bought 250 shares of stock himself,

permitted to complete what I had started. We had the stocklist, on microfilm at least. Since then the names and addresses of the stockholders have been put on IBM cards. And from those cards they can be "translated" onto envelopes.

But of course just getting the stocklist would not reform the company. So on December 31, I wrote the company asking it to submit three bylaw changes to the stockholders at the April 20 annual meeting. The first was that stockholders who were minors be allowed to vote their stock and exercise their other stock rights through their parents or guardians. The second was that no company money could be spent for lobbying without the approval of the board. The third was that no company money could be spent for false advertising or false communications to stockholders, by anyone, ever.

These were bylaw changes I proposed to the company. In Missouri, only stockholders can change the bylaws, so I proposed my changes under Missouri law. I did not propose them under Federal law.

The company accepted my second proposal, the one about lobbying, but on January 23 it protested the first and the third to the SEC. Just why to the SEC I don't know. I suppose it could have protested them to the Emperor of Japan if it wanted to. But I didn't see why the SEC would have anything more to do with my law-of-Missouri proposals than would the Emperor of Japan.

So I wrote SEC Chairman J. Sinclair Armstrong, on January 28, as soon as I received the company's objections, which had been sent me care of my father. I asked Mr. Armstrong whether I might have an attorney in the matter, and if so to please hold off action on the company's objections to my proposed bylaw changes 1 and 3 until my father had an opportunity to go into the matter. I also told Mr. Armstrong how absurd it was for the company to have sent my proposed bylaw changes to the SEC, since they were proposed under Missouri law.

I have never heard from Mr. Armstrong. I wrote him again, February 5, to no avail. Under date of February 15, long after the SEC, on January 30, had ruled, granting the company's objections, I did get a letter from Mr. Harvey A. Thorson of the SEC, taking a whole page to say nothing. I have that letter here.

I also have here the January 30 letter of Mr. Thorson ruling in favor of the company. It says that my proposed bylaw changes about stockholders who are minors, and about false advertising and false communications by management to stockholders, were not proper subjects for stockholder action under Missouri law.

Well, that's that, I suppose, though just why the SEC, in a matter that does not concern it at all, should say what Missouri law is, I don't know. And say it wrong at that. I had attached to my letter of January 28 to Mr. Armstrong a legal opinion of Mr. Samuel A. Mitchell, of the law firm of Thompson, Mitchell, Thompson & Douglas, in St. Louis. Mr. Guy Thompson was formerly president of the American Bar Association, and Judge Douglas was formerly chief justice of the Missouri Supreme Court. And Mr. Mitchell, who is attorney for the Mercantile Trust Co., in St. Louis, another Missouri corporation in which I own stock, had let my father act as my attorney in proposing a bylaw change, and vote my stock as my proxy, at

the January 14 meeting of the Mercantile stockholders. Mr. Mitchell's legal opinion, which I sent to Mr. Armstrong, so stated. I have a copy here.

The Union Electric management contended to the SEC that false advertising and false communications to stockholders were all covered by public laws and regulations issued by regulatory bodies. They didn't cite them, or say which ones. I have the correspondence here. But I know that such public laws and regulations as exist are very limited in scope. You have just listened to my father, and you know what the loopholes are. My bylaw No. 3 would have plugged the gap in Union Electric. But evidently neither the management nor the SEC wanted that gap plugged.

I agree with my father that there should be some laws against false advertising and false communications to stockholders, particularly in the atomic field. That is the field in which it is easiest to fool people. Not very many people know very much about atomic energy. If it was red, and some otherwise reputable company said it was green, a lot of people would believe it. Particularly stockholders. They are apt to take as gospel whatever the managements of their companies say. Or, if they don't believe it, they just sell their stock.

I spoke of stockholder responsibility a few minutes ago. I will try to illustrate what I mean. Last January 15, I received a letter from a boy in West Virginia I didn't know. It was a sort of fan letter. He was studying law and accounting and finance, and had read about me in the newspaper. He asked me two questions: why I thought the management of Union Electric should be reformed, and what specific recommendations I was going to suggest to the stockholders. I have his letter here.

The body of my letter, written January 25, a copy of which I have here, was as follows:

> I am against the use of improper influence in the securance of legislation. I believe that corporate managements should be truthful in their correspondence with the stockholders. I am against chicanery and deceit in corporate advertising, whether of the corporation's products or of the integrity and general superiority of its management, and I believe in economic democracy as well as political democracy—a corporate management should act in the best interests of the company and its stockholders, not in their own best interests.
>
> My answer to your second question concerning what I am going to do is based largely on the expression of principles in the first answer. Every stockholder has a responsibility for the policy of a company, and I am assuming mine.

That states, in a nutshell, and in my own words, what I mean by stockholder responsibility. Others have expressed it better, and more fully. I refer you to a book that came out last March, by Lewis D. Gilbert, entitled "Dividends and Democracy." I have it here.

Or, if you would prefer a short résumé of what is in the book, a review of it is scheduled to appear in the St. Louis Post-Dispatch. I have a manuscript copy of that book review here. It was written by my father and is 1,200 words long. I subscribe to it, and will read it if you like.

The CHAIRMAN. I believe, Miss Dyer, you are the youngest witness we have had, and we are very glad to have you.

Mr. Cole, any questions?

Representative COLE. No questions.

Representative PRICE. No questions, but I am glad to welcome my

neighbor from St. Louis to the committee hearing, although I feel the subject discussed is probably not within the preview of the statutory hearing, I think it is a good thing for the committee to know something of the reaction of others to the advertisements, the authenticity and accuracy of which, are certainly open to challenge.

Representative PATTERSON. I have no questions.

The CHAIRMAN. Thank you very much. We are glad to have you.

The next witness is Mr. Fred W. Hottenroth, of the Hupp Corp., of Cleveland, Ohio.

Mr. HOTTENROTH. Thank you, Mr. Chairman.

The CHAIRMAN. I see you have a statement, and you may proceed.

STATEMENT OF FRED W. HOTTENROTH, TECHNICAL VICE PRESIDENT OF HUPP CORP., CLEVELAND, OHIO

Mr. HOTTENROTH. Mr. Chairman and committee members, the following is a summary of a statement attached here to be submitted for your consideration and information. The Hupp Corp. is——

Representative COLE. Mr. Chairman, are we going to have both the summary and the statement?

The CHAIRMAN. Are you going to read the entire statement?

Mr. HOTTENROTH. I will read the entire statement.

Representative COLE. Then there is no point in having the summary.

The CHAIRMAN. Very well, you may read your full statement.

Mr. HOTTENROTH. I am Fred W. Hottenroth, technical vice president of Hupp Corp. In behalf of Hupp Corp., I wish to express appreciation to your committee for extending an invitation to present our views for your information and consideration.

In common with much of United States industry, we, in Hupp, have a very keen interest in your current efforts to produce legislation which both safeguards our vital national defense and encourages accelerated industrial development of atomic energy. This objective poses many difficult problems, but, to the extent to which some of those problems have come to our attention, we feel that compatible solutions can be formed.

I should like to bring to your attention today, the problems and recommended solutions, as we see them, relating to inventions made outside the scope of United States legislation and United States control. These inventions have many important industrial attractions. If they remain excluded from United States use, we not only deprive ourselves of prospectively significant business, but also we conceivably fail to support, challenge, or cross-fertilize the ideas of our own scientific and engineering personnel to the detriment of our national prominence in the vital atomic-energy field.

CONSIDERATION OF FOREIGN PROPOSAL

Hupp Corp. is considering a proposal from a group in a western European country having a newly developed fractionating process for the production of heavy water. Heavy water is well known as the most efficient moderator, from the physics standpoint, for a reactor and permits the use of natural uranium rather than enriched uranium as a fuel. The only commercial use of heavy water in significant quantities is in reactors, and the proposed entrance of Hupp Corp. in this

field is for the sole purpose of producing heavy water for use in reactors.

The price which the Commission has established for heavy water is $28 per pound. We have been advised by one of the divisions of the Commission that this price represents operating expenses and amortization of the Commission's most efficient plant over a 15-year period, and that the Commission will welcome the entrance of privately owned facilities in this field to produce heavy water at this or a lower cost. We understand that $28 per pound is a nonprofit figure and, also being a Government cost, does not include some items which have to be included in the costs of a private enterprise.

The details of the processes used by the Commission in producing heavy water are still classified, and presumably are not known in complete detail to our foreign associates. Their evaluation of the new process, accordingly, is not as reliable as it might be if they had the full information. Based on what information we have without asking for classified material, it is believed the newly developed process will produce heavy water at a cost of one-half or two-thirds of the established AEC price in quantities of the order of 8 tons per year if an optimum-production installation is constructed. Since the total market last year was in excess of 100 tons, according to the Commission, we at Hupp believe this offers a sound business investment which a corporation of its size can handle, possibly even without Government assistance, and we are, accordingly, interested in the United States rights in this new process.

LICENSE REQUIRED FOR OPERATION OF PLANT

Since heavy water is neither radioactive nor fissionable, it would seem, from an outsider's viewpoint, licensing of production facilities for heavy water by the Commission would be unnecessary. But under sections 101 and 109 and the definition of "production facility" as including a "component especially designed" for a reactor inherently producing plutonium in the Atomic Energy Act of 1954, it is inescapable that a license issued by the Commission is essential before Hupp could operate this process.

To obtain a license, the Commission must first make a finding of practical value under section 102. In the absence of a request for Government financial assistance, this seems unnecessary.

Under section 103, the applicant for a license must meet the requirements under "d," which states:

> No license may be issued to any corporation or other entity if the Commission knows or has reason to believe it is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government.

If Hupp enters into an agreement establishing a relationship of some type with the foreign group whereby Hupp receives exclusive rights in the United States for this process, there is a risk that the Commission may deny a license on the basis of possible control over the installation exercised by the foreign group, particularly if joint enterprise is set up for constructing the plant. Moreover, to obtain a license for operating a production facility of this type under section 103 "b" (3) Hupp Corp. will have to agree to make available to the Commission such technical information and data amounting to a full

disclosure of the process which the Commission "may use for the purposes of the common defense and security." Presumably this means setting up or arranging for others to use the process if the Commission determines additional production facilities for production of heavy water are warranted in the future and this process is the most desirable. Such conditions are not conducive to obtaining disclosure of the new process and result in complexities that may very well prevent Hupp from successfully completing its negotiations.

REPORTING OF PROCESS UNDER PATENT PROVISIONS

Under section 151 (c) of the Atomic Energy Act of 1954, any person who has made an invention useful in the production of atomic energy must file with the Commision a report disclosing the invention unless a patent application is filed in the United States Patent Office within 90 days after the invention is made. The language does not exclude alien inventors.

The only court decision interpreting the language "useful in the production of fissionable material" has held it to include such auxiliary equipment as spectrometers which were used to train maintenance personnel for operating gaseous-diffusion plants. A similar interpretation of the language "useful in the production of atomic energy" would undoubtedly include a process for producing heavy water in view of the fact that the only commercial use of heavy water is in reactors.

While the inventor is outside the United States, our laws are ineffective as against him. But what happens if he comes to this country to assist in the construction and operation of the plant?

There then results in this case an apparent failure to comply with the reporting procedure within the stated 90-day time period since the alien inventor has not reported the invention to the United States Atomic Energy Commission, nor to our knowledge, filed a United States patent application as yet. There being no specific penalty set forth in the act, section 223 is apparently applicable; such section provides for punishment by a fine up to $5,000 and imprisonment up to 2 years for such violation, and a fine up to $20,000 and imprisonment for 20 years if the offense is with the intent to injure the United States or to secure an advantage to a foreign nation.

Failure to report an invention is certainly not a crime against the state warranting such punishment, no matter what the invention is or who made it. To us, it seems this compulsory-reporting requirement is an unreasonable form of control by the Government over its citizens and aliens who subsequently visit this country, and should be modified.

NEW INFORMATION AUTOMATICALLY RESTRICTED DATA

The definition of restricted data under section 11 (r) is so worded that new inventions, discovery, measurements, and the like relating to weapons, special nuclear material, and to the production of energy from such material are all classified as restricted data by operation of law until declassified.

The special penalty provisions controlling the communication of restricted data under sections 224 through 227 of chapter 18 are so

broad as to apply to information which originates in a foreign country or is received by a person in this country from an alien.

In a reactor using uranium having a natural-isotope distribution as a fuel with which heavy water is a satisfactory moderator material, plutonium is inherently produced. It appears, therefore, that a new process for producing heavy water is automatically restricted data, even though the process is unknown to the Commission. Such a result is logicaly absurd, but nonetheless appears to exist unless excepted under section 142 (e). There, however, only information concerning the atomic-energy programs of other nations is considered for removal as restricted data; inventions by aliens apart from foreign atomic-energy programs are not mentioned, and thus presumably are restricted data until declassified.

Hupp Corp. and its officers cannot safely receive a full disclosure of the process from the foreign country because the disclosure is prima facie restricted data, even if the Commission doesn't know of the process. Further, there remains the possibility the Commission already knows of the process and is retaining it officially classified as restricted data.

DIFFICULTIES FACED BY PRIVATE INVENTORS

The above example points up some of the difficulties confronting an organization in connection with licensing in the nuclear-energy field. We also call to your attention some difficulties encountered by private individuals in obtaining reasonable protection for inventions in this same field.

Where a person has at his own expense and effort made an invention or improvement which mankind did not have previously, he is not taking anything away from the public by retaining the right to exclusive use of his invention for a limited period of time. This was recognized when the Constitution was written. Why then should the Government require a full disclosure of his invention under conditions as here exist when the individual cannot receive just compensation for the use of the invention because he failed to comply with the 90-day reporting requirements in section 157. Moreover, with the secrecy surrounding the plants and processes used by the Commission, an individual outside the Commission rarely knows when his invention is used by the Commission or disclosed by the Commission to others for their use. Even where there is actual use and the inventor is morally and legally entitled to payment either by an award or under patent rights, the Government is a formidable opponent and thousands of dollars are necessary to enforce such rights as the private individuals yet have in a field where the protection of the public interest is being continuously expanded at the expense of private rights.

Many worthwhile inventions and discoveries have originated outside the United States. The work by Fermi and his associates in 1934 in Italy with slow neutrons and the recognition of the fission of uranium by Hahn and Straussman in 1938 in Germany are but two examples of important basic discoveries and inventions by aliens right in this field. Legislation in this country should encourage introduction of inventions made by aliens into this country to permit its continuing technological advance instead of adversely affecting their

rights to the extent important foreign developments are withheld from the United States in the future.

For example, following World War II, the Boykin Act (60 Stat. 940) permitted aliens to obtain United States patents on inventions made in nonenemy countries during the war. One condition was that any patent issued in the United States expired 20 years from the date of the application for patent in the foreign country rather than having the usual 17-year life after the date of issuance in the United States. Patent applications were filed in the United States under the Boykin Act based on inventions made in the atomic energy field in 1939 through 1941 in foreign countries. These applications were classified as security information by the United States Government and patents were denied as being barred by the Atomic Energy Act of 1946. Patenting of these inventions is, in some cases, not barred under the terms of the Atomic Energy Act of 1954, and under section 160 can be reinstated before the Patent Office.

However, patents on applications filed under the Boykin Act expire 20 years after the date of filing in the foreign country's patent office. Such United States patents on inventions made in the atomic energy field in 1939 will expire as early as 1959 or 1960. Because of the usual delays incurred in prosecuting these applications before the Patent Office, the patent rights in some cases will actually expire before patents can be issued, and in any event will only extend for 2 or 3 years as a maximum on some inventions.

This is an unfair situation brought about by the special legislation relating to atomic energy which temporarily barred the issuance of patents for 8 years, that is during the period the Atomic Energy Act of 1946 was in effect, and in the case of patent applications filed under the Boykin Act, this resulted in the taking away of more than 8 years from the already shortened life of the patent. Such patents should, in all fairness, be given a life of at least 10 years and certainly not less than 8 years after actual issue of the patents.

The automatic classification of all new discoveries and data relating to atomic energy as Restricted Data is unrealistic and cannot be enforced. Scientists in foreign countries are continually making advances and further discoveries which are published and circulated throughout the world in many instances. Where a United States citizen has gained access to information originating with an alien or from a university or atomic energy research organization in a foreign country whether by publication or private disclosure, he should be safe to use this information in any manner as he chooses without fear of fine or imprisonment by the United States Government. Under a literal interpretation of the law, alien inventors and foreign governments in particular are denied the right to assistance by anyone in the United States for procuring protection of invention rights in new developments classified as restricted data.

The public as well as many Members of Congress have been misled to a large extent regarding the contributions by scientists in foreign countries in the development of nuclear physics which made possible the atomic bomb and nuclear reactors. A review of the literature published in 1939 before the war in Europe interrupted research there, and of patents issued in foreign countries where there has been no proscriptions against patenting in the atomic-energy field, shows the

United States had no monopoly on the scientific principles and early designs of either the atomic bombs or reactors. (See Nucleonics, vol. 12, No. 10, October 1954, pp. 64 and 65).

According to the Official Report on Atomic Energy for Military Purposes by Henry D. Smyth, sections 3.12 and 3.16, this Government had expended no more than $33,000 up to May 1941. Dr. Arthur H. Compton, an active participant in the atomic-energy program in this country, in his recent book entitled "Atomic Quest," published by the Oxford press, on page 49 states that at this time in 1941, the Government's responsible representatives were very close to dropping fission studies from the war program. The contribution by the British prior to and immediately following this period was outlined by Lord Waverly as background material for the Quebec Agreement signed in August 1943 by President Roosevelt and Prime Minister Churchill according to the British book Atom Harvest by Leonard Bertin, published by Secker & Warburg 1955, pages 70–79. The principal role of this Government in the early atomic-energy field was the financing of this expensive development program after feasibility had been proven by individuals outside this Government both in foreign countries and in the United States.

Britain and Russia have both already demonstrated their ability to duplicate this development program and it is only a matter of time until other countries will have the scarce materials enabling them to quickly attain the same results at costs they can afford.

With the reasons for strict secrecy rapidly disappearing, it is submitted that restrictions preventing cooperation with business groups in at least friendly foreign countries should be completely removed so that free interchange of information can again become possible and business in the atomic energy field be carried forward on a normal basis. Where weapons and radioactive material are not involved, Government control and regulation should be eliminated or at least restricted to practical limits.

FURTHER ACTION BY HUPP IS DELAYED PENDING RECEIPT OF OPINION FROM COMMISSION

We have recently presented the foregoing problems relating to acquiring rights in the heavy water process to the Commission and asked advice whether, under the existing law, HUPP can enter into an agreement to receive a disclosure of the new process and be able to have a license for a production facility; and if so, what obligations it has in reporting the process to the Commission.

Our questions were referred to the Commission counsel who courteously pointed out the relevant sections of the existing law and applicable regulations and stated that the Commission was not in a position to render legal opinions to private parties as respects interpretations of the Atomic Energy Act. The officers of HUPP Corp. are not going to jeopardize themselves by acting in the face of the strict penalty provisions in this act without reasonable assurance against prosecution under the penalty provisions and do not wish to spend the corporation's money in obtaining the disclosure and know-how of the process without the legal right to control its use in the United States on either a confidential or exclusive basis.

We, as well as many other corporations, have foreign associates with whom new products, processes and know-how are commonly exchanged. The principal means of enforcement of such agreements is by patents obtained in the various countries involved. No special legislation prevents the obtaining or interferes with the normal use of patents in such countries as Canada, Britain, France, and West Germany, where many United States firms have associates. Developments in the field of atomic energy, particularly in components and auxiliary equipment is progressing remarkably fast, and in the opinion of some, now is in advance of the United States. We believe, from the representations made to us by our foreign associates, this new heavy water process may be one. If the laws in this country preclude receipt of knowledge of such processes and inventions, or permit their use only on conditions confiscatory of the property rights involved, then both HUPP and the people of the United States will continue to lose valuable rights. This situation will contribute to our country falling behind foreigners not only in commercial, but also possibly eventually in military development and use of atomic energy.

In view of the foregoing, the following suggested revisions are proposed for consideration:

PROPOSED CHANGES

I. It is proposed that licensing and regulation by the Commission be limited by express language to fields where control of the subject matter is warranted on the basis of common defense and security or health and safety of the public is involved. If the subject matter is the production of a material neither fissionable nor dangerously radioactive such as heavy water, then licensing by the Commission should be unnecessary.

This, we submit, could be accomplished by modifying the definitions in chapter 2, section 11 (p) of production facility by deleting that portion following (2) whereby the definition will read as follows:

(*p*) The term "production facility" means any equipment or device determined by rule of the Commission capable of the production of special nuclear material in such quantity as to be of substantial significance to the common defense and security, or in such manner as to affect the health and safety of the public.

A corresponding change should also be made modifying the definition in paragraph (v) of utilization facility whereby the definition will read as follows:

(*v*) The term "utilization facility" means any equipment or device, except an atomic weapon, determined by rule of the Commission to be capable of making use of special nuclear material in such quantity as to be of substantial significance to the common defense and security, or in such manner as to affect the health and safety of the public, or solely and peculiarly adapted for making use of atomic energy in such quantity as to be of substantial significance to the common defense and security, or in such manner as to affect the health and safety of the public.

II. Reporting of inventions under section 151 (c) should be made permissive and no penalty involving a fine, imprisonment, or loss of property rights should exist.

No objection is raised to permitting an inventor who complies with the reporting requirements to be eligible for an award as now exists.

However, a specific express exemption to any penalty under the enforcement provisions in chapter 18 should be made. For example, section 223 could be amended by adding at the end:

*** * * *Provided, however*, That no penalty under this section shall apply to noncompliance with section 151.**

III. The definition of "Restricted data" should be amended to exclude information originating outside jurisdiction of the Commission. The definition under section 11 (r) should be amended to read as follows:

(*r*) The term "Restricted data" means all data originating within or under control of the Commission concerning (1) design, manufacture, or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy, but shall not include data declassified or removed from the restricted data category pursuant to section 142.

In any event, information received by United States citizens from sources in foreign countries should not be classified.

IV. Patents on applications filed under the Boykin Act (Public Law 690, 79th Cong., 2d sess., ch. 910; 60 Stat. 940) and reinstated under section 160 of the Atomic Energy Act should be guaranteed a minimum life of 10 years to compensate for the time patent rights were revoked between 1946 and 1954 and for the extra time required for the Patent Office to take action. For example, section 160 could be amended by adding at the end:

***Provided further*, That any patent issued upon any application so reinstated shall be in full force and effect for a period of no less than 10 years notwithstanding any other limitation in the Boykin Act, 60 Stat. 940.**

The CHAIRMAN. Thank you very much, Mr. Hottenroth. We appreciate your suggestion very much because it has been part of the act and remains under continuous study all the time.

I am not familiar with your corporation. Do you manufacture articles?

Mr. HOTTENROTH. The Hupp Corp. was originally the manufacturer of the Hupmobile, which I am sure you will remember very well. We now manufacture refrigerators at Gibson. The Perfection Heater Co. is a division; and so is the Typhoon Heat Pump Co. We have our own aviation company which manufactures components for jet engines to the tune of about $10 million a year. It is an amazingly large company to have so little known about it that a gentleman like yourself should not have heard of it.

The CHAIRMAN. I have heard of the corporation. I used to run a Hupmobile.

Mr. HOTTENROTH. It was a very good car, and we still make very good products. We are very much interested in developing foreign interests. We have a number of foreign connections.

This is honestly something that does hold up our opportunity to do business with good friends in friendly European countries.

The CHAIRMAN. Your primary trouble at the present time is doing business with foreign individuals?

Mr. HOTTENROTH. We would like to get into the atomic-energy field because we think it is the fastest growing field and this is a major difficulty because we think our easiest way of getting in is to utilize the know-how of some of our foreign associates.

The CHAIRMAN. Mr. Cole.

Representative COLE. I have no questions, Mr. Chairman. Mr. Hottenroth has brought to the attention of the committee a phase of the act which unquestionably needs some attention. It is very technical in detail. I have no doubt that the committee will give it some consideration. It is the first time I have heard this particular problem raised in criticism.

Mr. HOTTENROTH. It is a real problem. I believe there are other large corporations besides ours who are also starting to encounter this difficulty. It does hinder the free flow of information coming into the country because we are not making it attractive for that information to come into this country.

The CHAIRMAN. I believe you are the only witness who has appeared on this point and bringing out this matter before the committee.

Mr. HOTTENROTH. I am interested in hearing that and rather surprised.

The CHAIRMAN. Thank you very much, Mr. Hottenroth.

Mr. HOTTENROTH. Thank you, gentlemen, for your attention.

The CHAIRMAN. Without objection, I have some statements from other individuals to go into the record. They are as follows:

A letter from Glenn L. Martin Co., signed T. F. Nagey, general manager, nuclear division.

A letter from American Water Works Association, signed by Harry E. Jordan, secretary.

A letter from Allis-Chalmers Manufacturing Co., signed by C. R. Braun, manager.

A letter from Northern States Power Co., signed by Allen S. King, president.

Atomic Energy and Free Enterprise. Address by Hon. Herbert Brownell, Jr., Attorney General of the United States, before New York Bar Association, January 24, 1957.

Impact of Atomic Energy on Fossil Fuels. A paper prepared by R. C. Dalzell and Harry Perry for presentation to American Society of Mechanical Engineers, Washington, D. C., October 25–26, 1956.

Where Reactor Development Stands Today. Article by James A. Lane, of Oak Ridge National Laboratory, in August 1956 issue of Nucleonics magazine.

Why British Claim Lead in Nuclear Power. Article in December 1956 issue of Nucleonics magazine.

The Challenge of Nuclear Power, an address by Admiral H. G. Rickover, before the Navy Guided Missile Preview luncheon, March 1, 1957.

(The statements referred to follow:)

FEBRUARY 27, 1957.

STATEMENT FOR THE JOINT COMMITTEE ON ATOMIC ENERGY, UNITED STATES CONGRESS

The Glenn L. Martin Co. is most appreciative of this opportunity to file a statement with the Joint Committee on Atomic Energy. The matter proposed is not of major importance by comparison with kindred problems currently under consideration by the committee, but it is a device which would do much to facilitate administration of the program both domestically and abroad. We are suggesting the compilation and publication of information in the form of a user's handbook.

The Glenn L. Martin Co. is presently in the third year of a program designed to result in a significant role in the program for peaceful applications of atomic

energy. One area of interest has consisted of the immediate market for both research and power equipment in the Central and South Americas. In our opinion, electrical generating equipment, utilizing a nuclear heat source, is now economically competitive with existing power systems in many countries in this hemisphere. In the course of our extensive conversations with representatives of these countries, we have repeatedly been impressed with the lack of information available to foreign customers in a variety of areas affecting the acquisition of both research and power equipment. A large part of the time of an American manufacturer is consumed in imparting to foreign customers information on bilateral treaties, nuclear fuel costs, license requirements, etc. Secondly, in an appreciable number of cases the manufacturer finds itself without answers to questions on fuel reprocessing, security agreements, hazards evaluation on power systems, education and training of foreign operating personnel. Not the least of the problems consists of the security restrictions imposed on the transmission of classified information regarding various components of the nuclear system to be sold. This limitation points up, with particular emphasis, the importance of bilateral agreements, since it is pursuant to such authority that restricted information may be transmitted. No details are available on the nature, extent or provisions of security agreements, executed pursuant to the bilateral agreements, since they are not divulged to anyone other than the signatory nations. The philosophy seems to be that since they deal with the mechanics of maintaining security, we achieve even greater security by classifying the methods employed. This may be sound logic but it certainly produces a wealth of questions by foreign customers regarding the details of such agreements. An American manufacturer can do little more than refer them to the Department of State.

There is considerable information available on the form and content of bilateral agreements. This is particularly true of research bilaterals, and the numerous research agreements already in existence attest to the relative ease of accomplishment. Power bilaterals present a more varied and commensurately complicated problem. Because of the variety of considerations affecting the specific provisions of power agreements, it does not appear possible to achieve the uniformity of research agreements; but some generalizations in handbook form would serve, as a minimum, to impress upon foreign interests the essential differences between the two.

Information on financing the acquisition of nuclear equipment has taken the form of releases by individual agencies. There does not appear to be any central reference to which a customer may go and provide himself with general information regarding potential financial assistance. Direct Government assistance on the acquisition cost of research reactors, Export-Import Bank loans and credits, World Bank loans and ICA assistance are sources, and there may be others. In any event, the recommended handbook should outline the general requirements for qualifying and indicate sources of detailed information.

There have been significant recent developments in the matter of property and liability insurance available to American manufacturers and users of nuclear equipment. This insurance is not presently available to persons operating such equipment outside the United States. However, the proposed joint method of coverage, involving private insurance up to specified amounts and governmental indemnity beyond this amount up to a specified maximum, could be portrayed for the information of American concerns and the guidance of foreign customers.

One of the subjects of major interest to a customer is the cost of nuclear fuels and special materials. Data similar to that incorporated in the AEC news release of November 18, 1956, would cover a large portion of this information. Some additional data of interest would be that dealing with financial arrangements during fuel fabrication and typical steps involved in processing the fuel from the form supplied by the Commission to the form desired for fabrication.

Chemical reprocessing of spent fuel is, of course, an area of major importance in nuclear power economics. Since there is no standardization of fuel elements and consequently no reprocessing industry as such at the present time, reprocessing arrangements will be somewhat irregular over the next few years. The position of the United States Government in these arrangements should be made clear to other nations and the appropriate steps for making arrangements with the United States Government could be conveniently outlined in a handbook of the type we are suggesting.

Another subject which could be conveniently summarized in such a handbook would be safeguards. By safeguards we mean those measures taken by the

United States Government to account for the use of all fuel made available to the customer nation in two ways:

First, the need for safeguards provisions in the bilateral agreement would be clarified;

Second, the limits of United States concern with their utilization of fuel could be clearly established.

Health physics requirements, particularly regarding reactor hazards analyses and reviews, are a vital part of a customer nation's activities in atomic energy. A definition of the role of the United States Atomic Energy Commission in hazards evaluation would be welcomed by customer nations as a part of a discussion of hazards and health physics.

A section dealing with the proper sources of technical information in the United States atomic energy program could very logically be included in a handbook of the scope under consideration. The proper persons and agencies to contact for technical information and the method of ordering documents from these persons and agencies would be valuable.

A subject of vital interest to almost all nations is that of education in the arts and sciences relating to nuclear industry. The existing facilities in the United States and the programs under development could well be summarized in a section of the handbook. Any assistance programs available to customer nations could be described in this section. The proper steps to be taken for placing personnel in educational institutions and AEC facilities, as well as industrial programs, should be presented also.

Some of the countries with a strong interest in nuclear energy have not yet set up a central agency for controlling activities in this new field. The advantages of such a central organization are not always appreciated. A section in the proposed handbook might well indicate the advantages by summarizing the major activities and areas of responsibility of the United States Atomic Energy Commission.

The Martin Co. has the firm intention of performing a significant role in the program involving peaceful applications of atomic energy. For the past 3 years the company has been devoting a constantly increasing effort to the necessary engineering and manufacturing of the nuclear portion of power generating systems. Consideration of a system of limited generating capacity for military use has led logically to development of a system capable of functioning as an integral part of existing hydroelectric and diesel-fired systems. As a result of extensive exploration of the foreign market we are convinced there are many areas in Central and South America where it can be demonstrated that nuclear power is now competitive with the cost of electrical energy generated by conventional heat sources. This interest in the foreign market has lead us to an awareness of many of the current difficulties in doing business in these areas—difficulties which could be reduced, if not eliminated, by a compilation of information in a handbook such as we propose.

T. F. NAGEY,
General Manager, Nuclear Division, the Glenn L. Martin Co.

AMERICAN WATER WORKS ASSOCIATION,
New York 16, N. Y., February 18, 1957.

HON. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. DURHAM: I greatly appreciate the communication received from you under date of January 18, which brought to my attention the scheduled hearings by the Joint Committee on Atomic Energy to be held during the month of February 1957. I brought your communication to the attention of the board of directors of AWWA at their annual meeting at the end of January. It was their opinion that there was no compelling reason for a personal appearance at this time. I personally presented a statement to your committee under date of March 1, 1956. The references in the earlier part of the 1956 statement to lack of knowledge concerning the use of radioactive materials as tracers, have been outdated by the dissemination of a considerable amount of published material in 1956. Several accounts of application of these tracer techniques in Britain and the United States have been published so that the information is now reasonably available to any individual who is competent to use the materials.

There was included in the 1956 statement a memorandum approved by the

joint policy committee of the American Water Works Association, the Conference of State Sanitary Engineers, the Federation of Sewage and Industrial Wastes Associations, and the Water and Sewage Works Manufacturers Association. That resolution pointed out the necessity for AEC to cooperate with the Federal, State, and local agencies, which as a part of their administrative responsibilties, are concerned with the protection of the public health. For your convenience I am attaching to this letter a true copy of material beginning on page 8 of the March 1956 statement, extending through page 11 of that statement. I firmly believe that the suggestions for certain additions to chapter 10 of the present law should be affirmatively considered by your joint committee during its present session.

Again I wish to thank you for your courtesy in bringing the hearings of your committee to my attention.

Cordially yours,

HARRY E. JORDAN, *Secretary.*

FEBRUARY 15, 1957.

Re Atomic Energy Act 1954—Recommendations concerning certain amendments to the act.

To the Joint Committee on Atomic Energy:

The American Water Works Association cooperates with the Federation of Sewage and Industrial Wastes Associations, the Conference of State Sanitary Engineers, and the Water and Sewage Works Manufacturers Association, in the activities of a joint policy committee. It is the opinion of this joint committee that with the widening application of reactor practices in the hands of licensed civilians, the problem of safety control widens at accelerated rates. We, therefore, conclude that the protection of public health and safety outside the installations of the Atomic Energy Commission itself, needs to be definitely assigned to lifetime specialists in public health administration—either at the Federal, State, or local level. This joint opinion is expressed in the following resolution:

"Whereas the expanding development of nuclear energy and nuclear materials including their commercial and industrial utilization as authorized by the United States Atomic Energy Act of 1954 will involve major problems in the control of waste materials so as to prevent significant health hazards from the planned disposal or accidental release of contaminants to the environment; and

"Whereas it is particularly important that water pollution or other impairment of surface or ground water resources be prevented; and

"Whereas State and local health departments and other agencies in the several States and the United States Public Health Service have legally delegated responsibilities for protection of the health and safety of the public, including supervision over the control and disposal of industrial and other waste materials, which responsibilities must be recognized, and

"Whereas for many years State and local health departments, the United States Public Health Service, and other agencies have studied the problems of water pollution, and have developed technical and administrative procedures for the control of waste materials and other environmental contaminants and, in many States, for supervision over the development and use of water resources: Therefore, be it

"*Resolved*, That the organizations below listed recommend that in further modifications of the Atomic Energy Act, (1) the inherent responsibilities of the States and of the United States Public Health Service in their respective jurisdictions for the protection of health and for supervision and control of the disposal of radioactive wastes and protection of water resources should be specifically recognized in this act; and (2) the Atomic Energy Commission should be clearly authorized to encourage and assist State health departments and other responsible agencies, by training and other means, to develop their knowledge and competency and to assume responsibility for health and safety aspects of nuclear energy operations.

This resolution has been officially approved by the joint policy committee of American Water Works Association, Federation of Sewage and Industrial Wastes Associations, Water & Sewage Works Manufacturers Association, and Conference of State Sanitary Engineers.

We venture the opinion that your committee will not object to our making certain definite suggestions concerning the text of the amendments we support.

We also suggest that there be added to chapter 10 following sections 103 and 104 the following new section:

"Every licensee under this act who holds a license from the Commission for the commercial or industrial utilitization of nuclear material, medical therapy, or research and development shall be subject to the supervision and regulations of any State public health department and/or water-pollution-control agency having jurisdiction, and shall also be subject to the jurisdiction of the United States Public Health Service under the terms of Public Law 845 or its successor act, with respect to the control and disposal of waste materials."

The addition of the above may lead your committee to clarify the present language in section 103 (b) and section 104 (b) and (c).

We have also noted the phraseology of sections 271 and 272 of the 1954 act. They read as follows:

"SEC. 271. AGENCY JURISDICTION.—Nothing in this act shall be construed to affect the authority or regulations of any Federal, State, or local agency with respect to the generation, sale, or transmission of electric power."

"SEC. 272. APPLICABILITY OF FEDERAL POWER ACT.—Every licensee under this act who holds a license from the Commission for a utilization or production facility for the generation of commercial electric energy under section 103, and who transmits such electric energy in interstate commerce or sells it at wholesale in interstate comerce, shall be subject to the regulatory provisions of the Federal Power Act."

We suggest the following new section to follow 271.

SEC. —. AGENCY JURISDICTION.—Nothing in this act shall be construed to affect the authority or regulations of any Federal, State, or local agency with respect to control of environmental health hazards or the protection of water resources.

We have also noted that, while the Western States have for a long period had on the statute books, laws governing the appropriation and use of water, many of the 1955 State legislatures in the East are considering the enactment of similar legislation. There are today very few places in the United States where a develpoment of an industrial plant involving use of such large quantities of water can be accomplished except through permit from a State agency which controls the allocation and use of water. Since licensed nuclear reactors are of necessity large users of water, the following addition to follow section 271 of the amended act is suggested:

SEC. —. WATER RIGHTS.—Nothing in this act shall be construed to affect the authority or regulations of any State agency or the validity of any State legislation governing the rights to, the development of, or the use of water resources.

Certified to be a true and correct copy of portions of a statement filed on March 1, 1956.

HARRY E. JORDAN, *Secretary*
(For American Water Works Association).

ALLIS-CHALMERS MANUFACTURING CO.
Milwaukee, Wis., February 26, 1957.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
The Capitol, Washington, D. C.

DEAR CONGRESSMAN DURHAM: We appreciate your invitation to submit a written statement, because it enables us to put in writing our thoughts concerning the work of your committee. It gives us the opportunity to say publicly that this Nation owes your committee a debt of gratitude for your perception and zeal in supporting the philosophy that atomic energy is the next far-reaching step in the production and application of power.

Possibly our opinion may have some value to you because of our active interest in atomic energy and its applications in the field of machinery manufacturing.

For many years Allis-Chambers has been a significant force in the research and development of power generation, transmission, and distribution equipment. For that reason, we have the experience which enables our people to perceive the magnitude of the potential for the use of atomic energy in generating power. Allis-Chalmers' interest in atomic energy is one of long standing.

Before World War II our scientists and engineers became active in connection with specific projects in the field of nuclear physics. During the war, we made valuable contributions to the Manhattan District work. We have cooperated in the programs of the Atomic Energy Commission by providing scientific and technical personnel and by supplying various types of equipment.

Recently Allis-Chalmers has had important participation in the work of Argonne National Laboratory in the construction of a 5,000-kilowatt experimental boiling water reactor which on schedule operated successfully at full power in December 1956.

That outstanding achievement by the laboratory under the Commission's original 5-year program is a major contribution in the development of nuclear power. It represents a springboard for further advancement of boiling water reactor technology for larger generating plants.

It is our conviction that atomic energy can be made competitive with conventional fuels. We are exerting our best efforts to that end.

For example, at the present time we are working with a group of utility companies associated with the Northern States Power Co. toward the construction of a full-scale atomic plant having a 60,000 kilowatt capacity. This includes a controlled recirculating boiling reactor (CRBR) of advanced design. Plans of this kind involve extensive research and development on the part of industry.

Given time, industry with the private funds at its command, can solve the research and development problems implicit in this work. But the Atomic Energy Commission has envisioned how much the work will be accelerated through its policy of providing industry with a proper measure of assistance to hasten research and development in connection with specific projects. The importance of that attitude on the part of the Atomic Energy Commission cannot be overestimated.

We believe that the Atomic Energy Commission's policies and programs to develop the technology of various types of power reactors are sound and will best help achieve the goal of bringing atomic energy into a competitive position with conventional fuels.

Very truly yours,

C. R. BRAUN,
Manager, Nuclear Power Department, Power Equipment Division.

NORTHERN STATES POWER CO.,
Minneapolis, Minn., February 26, 1957.

HON. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States,
Washington, D. C.

DEAR MR. DURHAM: We appreciated receiving your invitation of February 12 to present to your committee in its section 202 hearings a statement with reference to our present activities in the development of atomic energy for power production.

We have advised your office that, although we will not be asking for time to appear in person at your hearings, we would like to present a statement. This letter may be considered such a statement and may be included in the record of the hearings of the committee.

Our understanding of the many problems involved in this field has been greatly increased as a result of our activities during the past 8 months leading toward the development of an actual full-scale plant of substantial size embodying the use of atomic energy. We have come to appreciate the scope and importance of the research and development work which has been accomplished by the Atomic Energy Commission in the field both directly and through assistance grants to others.

We have been engaged with the Pioneer Service & Engineering Co.'s study group for approximately 5 years appraising the different reactor concepts and watching with interest the related developments in the field. It has been our intention in these studies to work toward the development of a full-scale project that would have promise of making a significant contribution toward the technical and economic progress in this field, and we have been exploring all areas of interest toward that end.

About the middle of last year we and a group of other utility companies in our area with similar interests found that the Allis-Chalmers Co. had conceived a design which promised a very substantial improvement in the output efficiency of the boiling-water reactor. This design concept looks particularly interesting to us and confirms some of the conclusions reached in our earlier work with the study group, leading us to the conclusion that we could make our greatest contri-

bution by supporting an advanced development of a relatively simple concept, rather than attempting to develop a new concept involving extensive basic research. After exploring the matter further, this group of utility companies has concluded that the construction of a full-scale plant to test the validity of these advanced ideas would constitute a significant contribution to the art, and that this can be done on a reasonable economic basis.

Accordingly we have associated with a group of utility companies including Northern States Power Co., Minneapolis, Mississippi Valley Public Service Co., Winona, and Otter Tail Power Co., Fergus Falls, Minn.; Interstate Power Co., Dubuque, Iowa Power & Light Co., Des Moines, Iowa Southern Utilities Co., Centerville, Iowa; Wisconsin Public Service Corp., Milwaukee, Wis.; Northwestern Public Service Co., Huron, S. Dak.; St. Joseph Light & Power Co., St. Joseph, Mo.; and Central Electric & Gas Co., Lincoln, Nebr. Certain other companies are expected to join the group in the near future.

It is planned to construct a 60,000-kilowatt powerplant with a boiling water reactor including the controlled recirculation feature and a new design of fuel elements conceived by Allis-Chalmers. The plant will be located on the Northern States Power Co.'s system, who will own and operate the installation. Several specific sites are being considered subject to AEC approval. Northern States Power Co. will capitalize an amount reasonably commensurate with the cost of a conventional powerplant of similar capacity and location. There are certain elements of the design proposed by Allis-Chalmers, including both the controlled recirculation feature and a new design of fuel element, which we understand are of distinct interest to the research staff of the Atomic Energy Commission. We expect to explore with them our mutual interest in these concepts in order to cooperate in their development.

We are in the process of forming a nonprofit corporation for handling the research and development contributions of the associated utility companies. We are also in the process of negotiating the contracts between the associates and with the Allis-Chalmers Co. In general it is the plan that Allis-Chalmers Co. will undertake to construct the project on a fixed-price basis. Pioneer Service & Engineering Company of Chicago will be the architect-engineers. These matters are, of course, subject to favorable action by the AEC on our application for a license to construct the project. We are continuing with work on development and design concurrently with the preparation of the necessary applications and contracts. Completion of the plant is scheduled for 1962 but we expect to proceed as rapidly as possible.

We are encouraged by the amount of insurance coverage which can now be obtained through regular channels, but we are aware that uncertainties exist in the overall coverage requirements. We sincerely hope that Congress will find a way of indemnifying projects like this against the unknown hazards which may lie beyond the scope of presently available insurance coverage.

Past experience with the development of steam boilers and turbines has graphically demonstrated the progress which can be made in improving the efficiency of even the simplest form of energy transformation by the process of continual development and improvement within a given concept. This has further encouraged us to undertake a project aimed at further improvement and development of a well-proven power reactor type.

As a company dedicated to the rendering of the most economical electric service possible to the people of our service area, we are continually searching for more economical fuel sources for thermogeneration, because fuel cost is one of the major elements in our operating expense. We are well aware of the limitations of our fossil fuel reserves in the face of our expanding energy requirements. We realize that there will be a continual rise in cost of conventional fuels and that new sources of energy must be developed both as a conservation measure and to continue to discharge our utility obligation. It is, therefore, imperative that we do all in our power to make the use of atomic energy for power production practical and economical. We have this very direct and practical motivation to do our part in advancing the science of power reactors, and we feel that the proposal upon which our group of companies is now embarking will make a very distinct contribution in advancing the design of atomic-fueled powerplants.

In the development of the present high-efficiency fuel-burning powerplants, the research of manufacturing companies has played a major role. They have been leaders in promoting advanced designs. We are, therefore, highly gratified to have been able to associate ourselves with a major manufacturing company

of powerplant equipment, in jointly working out some new concepts in the atomic field.

We have great hopes that, from the numerous practical projects and research developments now under way and being planned, atomic power will become competitive with present methods of generation both as to investment and operating costs.

Again, may I say, that we sincerely appreciate this opportunity, which you have so kindly afforded us, to present our views to your committee.

Very truly yours,

ALLEN S. KING.

ATOMIC ENERGY AND FREE ENTERPRISE

Address by Hon. Herbert Brownell, Jr., Attorney General of the United States, before The Section on Antitrust Law, New York State Bar Association, New York, N. Y., Thursday, January 24, 1957

It is indeed a pleasure to meet with you today. This morning, with your permission, I shall depart a bit from accustomed procedure. Instead of discussing general antitrust policy, my plan is to focus on promotion of competition within one field—atomic energy.

Ten years ago this month, the first Federal atomic-energy program under civilian auspices began. It was on January 1, 1947, that the Atomic Energy Commission assumed responsibility for civilian atomic development under the Atomic Energy Act of 1946.[1] Written when fear of the atom's destructive force wholly overshadowed its promise of commercial use, that act provided for Government monopoly over development of this new energy source.

However, experience under the 1946 act demonstrated the practical possibilities for its industrial application. And, to accomplish commercial use for the benefit of all, the most effective means, we believed, was free enterprise.

Against this background the Atomic Energy Act of 1954[2] was adopted providing an effective compromise between the need for close Government control and the desire for the fullest play for free markets. Its implementation presents the Department of Justice with a unique challenge. In this evolving industry, we attempt preventive measures to foster competition, rather than remedial litigation to undo the effect of anticompetitive action already taken.

With this in mind, my plan this morning is to begin by detailing the 1946 act. Building on this act, I turn, second, to the Atomic Energy Act of 1954. And, finally, I touch on this Department's efforts with the Atomic Energy Commission to promote competition in atomic development.

First, the Atomic Energy Act of 1946. At the time of the 1946 law, the overriding consideration was the need for close Government control. President Eisenhower, in 1954, aptly characterized the atmosphere in which this first Atomic Energy Act was written. As the President put it:[3]

To harness its power in peaceful and productive service was even then our hope and our goal, but its awesome destructiveness overshadowed its potential for good. In the minds of most people this new energy was equated with the atomic bomb, and the bomb spelled the erasure of cities and the mass death of men, women, and children.

Moreover, this Nation's monopoly of atomic weapons was of crucial importance in international relations. The common defense and world peace required that this monopoly be protected and prolonged by the most stringent security safeguards.

Reflecting these views, the 1946 act established a strict Government monopoly over the use and application of atomic knowledge.[4] Private industry was barred from owning fissionable material or facilities to produce it.[5] The use of such materials by private concerns was also barred.[6] They could participate in the development of atomic energy only under licenses from the Commission.[7] More-

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[1] 60 Stat. 755 (1946), 42 U. S. C., secs. 1801–1819 (1952).
[2] 68 Stat. 919 (1954), 42 U. S. C., secs. 2011–2281 (supp. III, 1956).
[3] H. R. Doc. No. 328, 83d Cong., 2d sess., 1–2 (1954).
[4] See the report of the Special Committee on Atomic Energy in S. Rept. No. 1211, 79th Cong., 2d sess., 14–15 (1946).
[5] 60 Stat. 760 (1946), 42 U. S. C., secs. 1804, 1805 (1952).
[6] Ibid.
[7] 60 Stat. 764 (1946), 42 U. S. C., sec. 1807 (1952).

over, any patents developed, even in the nonmilitary field, were made available to the Government and to all firms operating under Commission licenses.[8]

The period of governmental monopoly, however, saw marked changes in the conditions which had determined our policy.[9] Great strides were made in basic research and in military applications. Equally important, other countries were already turning to development of commercial applications for atomic power. The task of foreign countries was easier than ours. For their higher present cost of power meant that commercial atomic power might compete with conventional power at an earlier state of reactor development. By 1953, Great Britain and the Soviet Union were already making great headway in this effort. The United States was thus confronted with a worldwide race to develop commercial atomic power.[10]

Against this background, the purposes of the Atomic Energy Act of 1954 became clear. Still necessary was development of atomic weapons within the existing framework of controls and secrecy. Feasible now, however, was international cooperation with our allies in atomic matters. Finally, it was necessary to open the field to widespread industry participation to achieve rapid development of commercial atomic applications.

Consequently, this legislation sought to end total governmental monopoly. It relaxed the prohibitions over private participation in atomic developments, allowed freer access to hitherto restricted technological data and permitted private ownership and use of production and utilization facilities. In effect, a measure of competition was now permitted with the framework of an industry still closely regulated.

Passage of this legislation occasioned lengthy hearings [11] and sharp differences of opinion. The legislative history of the act—bills, hearings, reports, and congressional debates—fills three enormous volumes.[12]

Several provisions, however, deal directly with safeguards to preserve free competition. It is in the area of licensing and patents that the extent of competition in civilian development of atomic energy will largely be determined.

There were special problems in this area. During the period of Government monopoly, much of AEC operation and research had been performed by private firms under contract. Private firms had thus gained access to a great deal of restricted data, acquired the necessary scientific staffs, and had accumulated a mass of technological know-how. Without effective controls to offset these advantages, it was feared that potential newcomers to the industry would be deterred by the dominant position these firms would quickly achieve.[13]

Provisions of the act designed to insure competition received careful consideration in the light of these special problems.[14] Many conflicting proposals were made.[15] Not surprisingly, therefore, the terms of the resulting statute are, in large part, the product of compromise.[16]

The statute's most basic competitive safeguard is provision for normal application of antitrust to the civilian atomic industry. Section 105 of the act [17] carefully reaffirms our belief that these laws are basic to the maintenance of free enterprise. In addition, that section requires that the Commission report promptly to the Attorney General any indication that any private use of special nuclear material or atomic energy may raise antitrust problems.

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[8] 60 Stat. 768 (1946), 42 U. S. C., sec. 1811 (1952).

[9] See the discussion of the background of events against which the 1954 act was passed in Palfrey, Atomic Energy: A New Experiment in Government–Industry Relations, 56 Colum. L. Rev. 367, 369–372 (1954).

[10] Hearings before the Joint Committee on Atomic Energy on Atomic Power and Private Enterprise, 83d Cong., 1st sess., at 58, 65 (1953). Indeed, at the present time, Britain is already considering bids submitted for the construction of its first two commercial atomic power stations. See the articles, Atomic Contest, the Economist, December 1, 1956, p. 801.

[11] Hearings before the Joint Committee on Atomic Energy on S. 3323 and H. R. 8862, To Amend the Atomic Energy Act of 1946, 83d Cong., 2d sess. (1954).

[12] U. S. Atomic Energy Commission, Legislative History of the Atomic Energy Act of 1954 (Public Law 703, 83d Cong.), 3 vol. (1955).

[13] See Adams, Atomic Energy: The Congressional Abandonment of Competition, 55 Colum. L. Rev. 158 (1955), reprinted as ch. VII in Adams & Gray, Monopoly in America (1955).

[14] Similar problems with respect to Government research and development work generally are discussed in Report of the Attorney General Pursuant to Section 708 (e) of the Defense Production Act of 1950, as Amended, November 9, 1956.

[15] See for example: Sec. 106 of H. R. 8862 and its companion bill, S. 3323, 83d Cong., 2d sess. (1954); sec. 105 of H. R. 9757 as introduced, 83d Cong., 2d sess. (1954).

[16] H. R. Rept. No. 2666, 83d Cong., 2d sess., 30 (1954).

[17] 68 Stat. 938 (1954), 42 U. S. C., sec. 2135 (supp. III, 1956).

Apart from this general affirmation, other provisions of section 105 treat particular competitive problems. According to that section, for example, any grant of a commercial license, must be preceded by advice from the Attorney General whether its issuance would tend to create or maintain a situation inconsistent with the antitrust laws.

This provision, patterned after earlier surplus-property disposal laws[18] makes available to the Commission analysis of any special anticompetitive considerations presented. Antitrust advice, however, need not be controlling. For the Commission must also weigh the necessities of defense and security and public health and safety. Nonetheless such a procedure provides an effective means to insure that knowledge of possible antitrust difficulties required to foster competition.[19]

As the act now stands, then, the Commission must issue commercial licenses on a nonexclusive basis to all applicants who meet the conditions the act sets forth.[20] This provision promises the widest possible participation of all interested in entering the atomic field. It reduces the possibility that the limited number of Government contractors already in the field will retain their exclusive position.

That possibility is further decreased by the action of the Commission in permitting vital dissemination of restricted data.[21] Dissemination opens up to newcomers great areas of technological information hitherto available only to the contractors under the earlier Government program.[22]

Concern with anticompetitive considerations, let me emphasize, does not end with issuance of any commercial license. Licenses, once issued, are still subject to the antitrust laws. And licenses may be revoked by the Commission if subsequent information would warrant refusal of a license on an original application.[23] We interpret this language to include instances where a later investigation reveals anticompetitive factors unknown to this Department at the time the license was issued.

Considerable discussion arose over the present law's patent provisions.[24] The patent system is a fundamental factor contributing to the outstanding technological development of American industry. Many believed, therefore, that any curtailment of traditional patent rights would obstruct full and speedy development.[25]

However, technology's importance in this highly scientific field inspired the belief that curtailment of certain patent rights was necessary for competition to flourish. Particularly, the technical advantages gained by AEC contractors before the passage of the act suggested that important areas might be closed off to newcomers. The President called for temporary provisions to meet this need; as he put it:

Until industrial participation in the utilization of atomic energy acquires a broader base, considerations of fairness require some mechanism to assure that the limited number of companies, which as Government contractors now have access to the program, cannot build a patent monopoly which would exclude others desiring to enter the field. I hope that participation in the development of atomic power will have broadened sufficiently in the next 5 years to remove the need for such provisions.[26]

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[18] Sec. 207 of the Federal Property and Administrative Services Act of 1949, 63 Stat. 391, 40 U. S. C., sec. 485 (1952).

[19] See testimony of J. Lee Rankin in hearings before the Joint Committee on Atomic Energy on S. 3323 and H. R. 8862 to amend the Atomic Energy Act of 1946), 83d Cong., 2d sess., 712 (1954).

[20] Sec. 103 (b), 68 Stat. 936 (1954), 42 U. S. C., sec. 2133 (b) (supp. III, 1956).

[21] AEC regulations' Access to Restricted Data, 21 Fed. Reg. 810, Feb. 4. 1956, amended 21 Fed. Reg. 5733, Aug. 1, 1956.

[22] However, see the discussion of the problems remaining in this area, involving AEC's use of its discretion, in Green, Information Control and Atomic Power Development, 21 Law and Contemporary Problems, 91 (1956).

[23] Sec. 186 (a), 68 Stat. 955 (1954), 42 U. S. C., sec. 2236 (a) (supp. III, 1956).

[24] The patent provisions of the act are extensively analyzed in Boskey Patents Under the New Atomic Energy Act, 36 J. Pat. Off. Soc'y 867 (1954); Spear, Compulsory Licensing of Patents Under the Atomic Energy Act of 1954, 43 Geo. L. J. 221 (1955); Beckett and Merriman, Will the Patent Provisions of the Atomic Energy Act of 1954 Promote Progress or Stifle Invention? 37 J. Pat. Off. Soc'y 38 (1955); Ooms, Some Suggestions Relating to Patent Provisions in Atomic Energy Legislation to Protect the Public Interest, 38 J. Pat. Off. Soc'y 38 (1956); Boskey, Progress and Patents in Atomic Energy: the Military and Civilian Uses, 34 Texas L. Rev. 867 (1956).

[25] See, for example, the views of Representative Cole ,chairman of the Joint Committee, H. Rept. No. 2181, 83d Cong., 2d sess., 96 et seq. (1954).

[26] H. Doc. No. 328, 83d Cong., 2d sess. 7 (1954).

The act, as passed, provides that any patent issued before September 1, 1959, may be declared by the Commission, under certain conditions, to be affected with a public interest. The Commission itself may then use or license the invention or discovery covered by the patent.[27]

This provision has been criticized on the grounds that the condition governing compulsory licensing are too strict and the period during which it may be invoked too short.[28] Significantly, however, no special problems seem to have arisen under this provision. Moreover, other sections of the act relating to patents reinforce this section's effort to insure equality of opportunity.

Section 159, for instance, carefully preserves the Government's paramount rights to invention made by the individual concerns in the course of their work under contract.[29] Similar provisions were included in larger contracts during the period of Government monopoly.

An even more significant protection for the general public is found in section 152.[30] It provides a statutory affirmation of the Government's rights in inventions resulting from work under AEC contracts and extends those rights to other areas. Unless the Commission should, in its discretion, waive its claim, any invention made or conceived under any contract, arrangement "or other relationship" with the Commission, regardless of whether the relationship involved the expenditure of funds by the AEC, "shall be deemed to have been made or conceived by the Commission." This means that no person or firm can gain private patent advantages from ideas originating through past or future Government connections.

A final patent safeguard is the provision respecting antitrust violations in the use of atomic energy patents.[31] The statute specifically authorizes the courts to require reasonable-royalty licensing of patents involved in antitrust violations. While courts already have this power included within their general equity remedies, Congress has here clearly directed appropriate use of that remedy in this field.

This brief review has pointed out the various competitive safeguards in the act. Opinions differ as to their effectiveness. While I recognize that the act may not be perfect,[32] I feel that most criticism of the act's antitrust safeguards lies in the realm of theory. In its actual operation I believe the act appears adequate for the proper development of our free enterprise system at a time when both atomic developments and regulatory mechanisms to control them are still experimental. It is equally important that it grants the Atomic Energy Commission sufficient flexibility to meet the diverse major objectives of the act.

The Department of Justice is eager to meet the unique challenge presented by this new industry. We have an important role to play in fostering competition. We here have an opportunity to utilize preventive rather than merely remedial action. We must act to prevent anticompetitive tendencies before they mature into monopolistic patterns.

Since the passage of the 1954 act, the Department of Justice has worked closely with the Atomic Energy Commission. We have assisted the Commission in formulating regulations[33] governing civilian participation in atomic energy developments to ensure the implementation of the competitive safeguards in the act.[34] We have also consulted on general competitive problems involved in development of this new industry.

An example of the problems so far raised concerns the issuance of research and development licenses to private firms under section 104 of the act.[35] Because of the heavy expenses involved in construction and operation of experimental power reactors and other types of laboratory equipment, there has been

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[27] Sec. 153, 68 Stat. 945 (1954), 42 U. S. C. 2183 (supp. III, 1956).

[28] E. g., Adams, Atomic Energy: The Congressional Abandonment of Competition, 55 Colum. L. Rev. 158 (1955).

[29] 68 Stat. 948 (1954), 42 U. S. C. 2189 (supp. III, 1956).

[30] 68 Stat. 944 (1954), 42 U. S. C. 2182 (supp. III, 1956). See Palfrey, Atomic Energy: A New Experiment in Government-Industry Relations, 56 Colum. L. Rev. 367, 383 (1956).

[31] Sec. 158, 68 Stat. 947 (1954), 42 U. S. C. 2188 (supp. III, 1956).

[32] See, for example, the criticism that the act does not make more specific provision for the thermonuclear development. Walker, Legal Control of Thermonuclear Energy: The Atomic Energy Act and the Hydrogen Program, 52 Mich. L. Rev. 1099 (1954); Walker, Thermonuclear Reactions: Can They Be Used for Man's Benefit? 33 Foreign Affairs 605 (1955).

[33] 10 CFR, 1955 supp., p. 3 et seq. AEC regulations are also collected in 2 CCH Atomic Energy Law Reporter 15,001 et seq.

[34] See, for example, secs. 50.70 and 50.71, concerning inspections, records, and reports, 21 F. R. 360, 2 CCH Atomic Energy Law Reporter 15,064.

[35] 68 Stat. 937 (1954), 42 U. S. C. 2134 (supp. III, 1956).

a tendency to organize joint participation among a number of firms. Although the companies seeking such licenses jointly may not presently be engaged in the same industries, such activities still require considerable careful study, from a competitive point of view, both as to present actions in the experimental stages and in future activities when the commercial stage is reached. In the case of public utilities, I might add, such licenses for joint activities also raise the possibility of questions under the Public Utilities Holding Company Act.[36]

The volume of competitive problems in this field has not yet been large. Despite the glowing promise of the atom's commercial development, such promise is still but a hope. Aside from the use of radioisotopes, activities in the field are still completely experimental.[37]

Yet this experimental work shows that the industry will not be limited to a mere handful of previous participants. Virtually all segments of industry are alert to the possibilities of this new and dynamic field.[38] More than 1,000 persons and firms have already been granted access permits by the Commission to obtain technological information.[39]

Nevertheless we will keep a close eye on the developing situation in atomic energy. We will continue close consultations with the Commission and will advise them immediately of any situation which, in our judgment, may appear to present a serious tendency toward anticompetitive concentration. We are also prepared to inform the Congress without delay of any need which may develop for changes in the basic statutes to provide additional competitive safeguards.

The techniques of preventive action, though not entirely new to antitrust enforcement, here find their greatest opportunity for useful application. Preventive action must be applied wisely and well if we are to realize the great potential of this new industry for our future industrial well-being. For we are dealing here with a promise of future energy supply greater than all the unmined coal, all the untapped oil, and all the hydroelectric capacity now existing in the United States.[40] As the estimates of expanding future energy requirements indicate that conventional power sources may not be adequate for the task,[41] the introduction of this new source of energy becomes a vital necessity to enable us to maintain our industrial preeminence among the nations of the world. We are confident that the development of a great new industry in the spirit of full and free competition can be accomplished.

Impact of Atomic Energy on Fossil Fuels

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I. Introduction

Since the initial applications of nuclear reactions to military use, this Nation has made a concentrated effort to develop peaceful applications for this enormous energy reserve. The relation of cheap sources of energy to higher standards of living has been established by a number of studies, and the predicted continuing increase in per capita energy consumption in the future seems to be well founded.

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[36] 49 Stat. 838 (1935), 15 U. S. C. 79 (1952). See the general discussion on this subject in Murray, Atomic Electric Energy and the Holding Company Act, 24 Jour. B. Assoc. D. C. 20 (1957).

[37] A compilation of pertinent data on all current developments in construction of nuclear reactors for research and for experimental powerplants in the United States, both Federal and private, is contained in Nuclear Reactors Built, Building, or Planned in the United States as of October 1, 1956, 1 CCH Atomic Energy Law Reporter 2721.

[38] See Ooms, Some Suggestions Relating to Patent Provisions in Atomic Energy Legislation To Protect the Public Interest, 38 J. Pat. Off. Soc'y 38, 46 (1956).

[39] AEC Press Release No. 948, December 31, 1956, p. 8.

[40] Adams, Atomic Energy : The Congressional Abandonment of Competition, 55 Colum. L. Rev. 158 (1955).

[41] Hearings before the Joint Committee on Atomic Energy on Atomic Power Development and Private Enterprise, 83d Cong., 1st sess., 5–13 (1953) ; The President's Materials Policy Commission, Resources for Freedom, vol. III, p. 32 (1952).

Any new source of energy can be expected, therefore, to exert some effect upon our total economy and upon the fossil-fuel industries, which have supplied the bulk of the energy in the past.

The most obvious potential use of controlled nuclear reactions is for generating electricity. Intensive research efforts in this direction, both in the United States and abroad, have resulted in a number of reactor types, and some of them have been installed in prototype plants. On a smaller scale, research is also underway on the applications of nuclear energy in other fields, which may have an impact on the fossil-fuel industries. The more important of these include the propulsion of ships and aircraft, use in process and space heating, and a more recent development aimed at using nuclear energy to supply the heat for high-temperature endothermic reactions.

The most advanced technology for nuclear applications in nonmilitary areas is in power generation. The size and number of electric generating plants using nuclear fuels that ultimately may be constructed, as well as the rate of growth of this new competitor for the markets of coal, oil, and gas, will depend on many complex, interrelated factors. The exploitation of fuel supplies is contingent upon the size of the reserves, their geographic location, and, most important, the relative costs of power generated using the different fuels. The latter, in turn, is a function of the cost of production and transportation of the fuels, improved technology of utilization, powerplant capital costs, availability of water, and other numerous well-known factors.

II. ENERGY RESOURCES

Every nation desires to utilize, if possible, its indigenous fuel reserves, since energy is related intimately to its total economic health and to its military strength. Strong domestic industries producing the fuels for generating heat and power not only provide a segment of the population with a means of livelihood but increase potential military strength by avoiding dependence on imports of these vital materials. The increasing dependence of Western Europe on fuel imports from the United States and other countries suggests that the fuel resources of these countries be considered in this study of the United States fossil fuel-nuclear fuel situation.

Table 1 is a compilation of the most accurate information on fuel reserves that could be obtained. These data constitute an inventory of resources that are recoverable at or near present costs. Reserves that are not exploitable under present technologic and economic conditions have not been included.

Coal reserves in the United States are reported for beds more than 14 inches thick for coals of bituminous rank and higher and for beds more than 2½ feet thick for subbituminous and lignitic coals, with an overburden of 3,000 feet or less and with 50 percent recovery during mining. The Federal Geological Survey is revising estimates of reserves. All estimates (except for one State) have been less than the original estimates by M. R. Campbell in 1909, indicating that the total reserves may be lower than are shown in table 1 when the revisions are completed. On the other hand, improved mining methods may increase the percentage recovery and compensate for the decreased total reserves.

The latest estimate of reserves for petroleum and natural gas liquids (December 1955), published by the American Petroleum Institute, indicates a proved reserve of approximately 35½ billion barrels. Despite the rapidly increasing domestic demand for petroleum, these reserves have increased steadily each year since 1936.

The most recent estimate of natural gas reserves (December 1955), published by the American Gas Association, indicates a proved reserve of 224 trillion cubic feet. Except for 1 year, this reserve has also increased steadily since 1945, despite an increased annual consumption of more than 230 percent between 1945 and 1955.

TABLE 1.—*Proved fossil-fuel reserves of the United States and Europe (except U. S. S. R.)*

	United States		Europe (except U. S. S. R.)	
	Quantity	Bituminous-coal equivalent, million short tons	Quantity	Bituminous-coal equivalent, million short tons
Coal:	*Million short tons*		*Million short tons*	
Source A	358,348	----------	221,886	----------
Source B	[1] 948,000	----------	362,964	----------
Petroleum:	*Billion barrels*		*Billion barrels*	
Source A	37.3	8,260	0.732	0.162
Source C	35.4	7,840	1	0.221
Natural gas:	*Trillion cubic feet*		*Trillion cubic feet*	
Source A	197.9	8,160	0.168	8.24
Source D	224	9,230	3	123.7

[1] This is composed of the following figures:

Billion short tons at or near present prices	237
Billion short tons at 1¼ to 1½ times present prices	285
Billion short tons at 1½ to 4 times present prices	426
Total	948

Source A: Statistical Yearbook of the World Power Conference, No. 7, 1950–52. (Coal reserve figures refer to beds not less than 28 inches thick and less than 2,000 feet below the surface.)
Source B: Report of Panel on Impact of the Peaceful Uses of Atomic Energy, vol. II, ch. 2.
Source C: American Petroleum Institute.
Source D: American Gas Association.

Table 1 shows estimates of reserves from the various sources. Except for the coal reserves in the United States and natural-gas reserves in Western Europe, these sources agree quite satisfactorily. Since the reserves of natural gas in Western Europe are very small, the difference appears to be unimportant in the total energy picture. The difference in the estimates for the United States coal reserves for the two sources arise from differences in the assumptions regarding overburden and thickness of seams.

In table 1 the reserves of petroleum and natural gas have been converted to bituminous-coal equivalents. The enormous preponderance of energy reserves as coal in both the United States and Western Europe can easily be seen, indicating that coal must supply the bulk of the energy in the future unless nuclear power can be developed to be an economic competitor.

The ultimate resources of fissionable material in the world are immense, including, as they do, both uranium and thorium in ores of varying degrees of richness. Although U–235 is the only naturally occurring fissionable material. U–238 is convertible to plutonium in nuclear reactors, and thorium to U–233, both of which are fissionable. At this time the reserves of the producing areas of the free world are now estimated at approximately 1 million tons of uranium oxide, and there may be twice that quantity. This does not include low-grade deposits, such as shales and phosphates, that are not economic today. This 1 million tons represents a much larger potential source of fuel energy than all the coal reserves of the United States.

Much of the world is yet unprospected for fissionable materials. The potentialities of the important producing countries, such as the United States, still are largely unknown, for uranium exploration has been active only a few years. Consequently, our knowledge of the world's uranium resources is limited.

Thorium exploration has had far less attention than has uranium; accordingly, even less is known about thorium resources.

III FUTURE ENERGY REQUIREMENTS

Prediction of energy requirements is subject to very large probable error. Utilizing such sources as the Paley Commission's report, Palmer Putnam's book, Energy in the Future, and data from the McKinney Panel Report on Peaceful Uses of Atomic Energy, we have constructed tables 2 and 3. However, table 3

must be regarded as highly speculative. It is valuable principally as indicating a trend of the order of magnitude shown.

In other words, one is fairly safe in saying that the gross energy demands of the United States will increase from 39.5×10^{15} to 71.2×10^{15} B. t. u., or about 80 percent in 15 or 20 years. There is considerable disagreement as to details.

These tables have been prepared without consideration of nuclear energy. A dramatic technical breakthrough within 5 to 10 years in the field of nuclear energy might conceivably affect the 1975 gross demands, but this cannot be predicted with any degree of confidence. If a breakthrough occurs later than 1965, there will probably be little effect on the 1975 forecast as to demand, although there might well be somewhat larger shifts from fossil fuels to nuclear fuels to meet that demand.

TABLE 2.—*Estimated total of United States fuel consumption during 1955*

	Coal (thousand short tons) [1]	Oil (thousand barrels)	Natural gas (trillion cubic feet)	Hydroelectric power (billion kilowatt-hours)
Electric-power generation (public utility plants)	140,500	70,900	1.2	[2] 4.6 [3] 112.7
Propulsion:				
Motor vehicles		1,251,500		
Aircraft		126,500		
Railroads (class 1)	15,000	99,000		
Vessels	500	131,800		
Total	15,500	1,608,800		
Space heating (residential and commercial)	54,000	443,400	2.8	
Coke production	107,000			
Process heating and other industrial uses	106,000	[4] 948,500	5.3	
Grand total	[5] 423,000	3,071,600	9.3	117.3
B. t. u. equivalent total	11×10^{15}	17×10^{15}	10×10^{15}	1.5×10^{15}

[1] Estimates for bituminous coal only.
[2] Industrial.
[3] Utilities.
[4] Includes asphalt, liquefied gas, and lubricants.
[5] Total excludes 51 million tons for export.

Sources: Federal Power Commission. U. S. Department of the Interior. McKinney panel. Paley Commission.

TABLE 3.—*Estimated total United States energy demand during 1975*

	Coal (thousand short tons)[1]	Oil (thousand barrels)	Natural gas (trillion cubic feet)	Hydroelectric power (billion kilowatt-hours)
Electric-power generation	340,000	100,350	2.4	396.4
Propulsion:				
Motor vehicles		2,085,000		
Aircraft		[2] 280,000		
Railroads (class 1)	9,000	[3] 180,000		
Vessels		248,000		
Total	9,000	2,793,000		
Space heating (residential and commercial)	25,000	810,000	5.5	
Coke production	160,000			
Process heating and other industrial uses	263,000	[4] 1,161,650	7.7	
Grand total	797,000	4,865,000	15.6	[5] 396.4
B. t. u. equivalent total	21×10^{15}	29×10^{15}	17×10^{15}	4.2×10^{15}

[1] Estimates for bituminous coal only.
[2] Indicates marked increase in jet fuel.
[3] Reflects substantial increase in use of diesel fuel.
[4] Includes lubricants and kerosene.
[5] Includes industrial and utilities.

Sources: Federal Power Commission. U. S. Department of the Interior. McKinney panel. Paley Commission.

IV. INTERCHANGEABILITY OF FUELS

It is, therefore, pertinent at this point to consider from a technological standpoint the possibilities of shifting from one fuel to another to satisfy the expected requirements. For some markets fuels can be interchanged relatively easily, while in others interchangeability is impossible with present technology.

For example, unless drastic changes occur in iron-and steel-making practice, there is no suitable substitute for coke. Similarly, there appears to be little prospect for fuels other than liquid petroleum to be used in automobiles.

On the other hand, gas, petroleum, and coal are easily interchangeable for generating heat and power.

One facet of the general fossil-fuel situation merits special attention. It is obvious that a large portion of the energy demand in the next 20 years will be for fuels in liquid or gaseous form. There will be increasing domestic scarcity of these fuels from natural sources. Unless heavier reliance is placed on imported petroleum, a portion of the increased demand will be satisfied with products made from oil shale and from coal. Processes exist for converting oil shale to useful liquid products and for converting coal to gas—as a supplement to or a substitute for natural gas—and liquid fuels. At present, the economics is not encouraging, but as the technology of the processes is improved and the demand for such products rises, the competitive economic position can be expected to change.

In producing synthetic fuels from coal, one of the major costs is that of the synthesis gas or hydrogen used in the process. In an effort to decrease this cost, the Bureau of Mines and the Atomic Energy Commission are attempting to develop a reactor in which nuclear energy can be used to supply the heat for this endothermic reaction. Successful development of this reactor would eliminate the need for investment in oxygen equipment and would reduce coal usage during gasification one-third. If significant reduction in costs for the synthesis gas could be obtained, a potentially large new market for coal would be opened. For example, if only 5 percent of the 1975 requirement for liquid petroleum were supplied by coal gasification and synthesis, 100 million tons of coal would be required. Thus, although nuclear energy cannot compete directly in the market for liquid and gaseous fuels, it can probably aid indirectly in supplying this energy demand.

The most promising early uses of nuclear energy appear to be in power generation, space heating, process heating, and propulsion of large vehicles, such as ships. The rate of substitution of nuclear fuels for these uses will depend upon the obsolescence factor of present installations, the relative status of the various technologies, and the economics of the processes. Moreover, one must remember the limitations that are apparently inherent in a nuclear reactor:

1. Nuclear energy production requires special equipment and very heavy shielding.
2. It involves having as a minimum quite a substantial amount of expensive fuel in one place.
3. Although the ingoing fuel is readily transported and handled, the "ashes" must be removed by special means and must be heavily shielded while they are stored, transported, or processed.
4. The fuel cannot be completely consumed; therefore, the ashes must be processed to recover the unused fuel in all but the most unusual instances.

Now let us examine in somewhat more detail the technological situation as to the use of nuclear energy in these fields.

Power generation

Five distinct types of reactors have been developed in this country for producing power from nuclear fuels. These are: Pressurized water reactor, boiling-water reactor, sodium-cooled graphite reactor, fast breeder reactor, and aqueous homogeneous reactor. Each reactor type has inherent technical advantages and disadvantages, which have been discussed extensively in the literature. To date, the emphasis on development work has been on the pressurized water reactor and sodium-cooled graphite reactor. However, Commonwealth Edison plans to build a powerplant using the boiling-water reactor. The potential high breeding gain is an attractive feature of the fast breeder reactor planned by Power Reactor Development Co. The Pennsylvania Power & Light Co. is studying an aqueous homogeneous reactor. Table 4 summarizes the major differences among these reactor types.

TABLE 4.—*Types of nuclear reactors*

Reactor type	Coolant	Moderator	Remarks
Pressurized water	Light or heavy water.	Light or heavy water.	Heat exchanger to transfer heat from coolant to steam cycle.
Boiling water	do	do	Coolant may be used directly in steam cycle.
Sodium-cooled graphite.	Liquid sodium	Graphite	2 intermediate heat exchangers in series to transfer heat from coolant to steam cycle.
Fast breeder	do	None	Do.
Aqueous homogeneous.	Uranium salt dissolved in light or heavy water.	Light or heavy water.	Heat exchanger to transfer heat from coolant to steam cycle.

NOTE.—Water-cooled reactors are inherently limited to producing steam at relatively low pressures and temperatures.

Process and space heating

The use of nuclear fuels for process heating on a competitive economic basis appears to be further from realization than generation of power except in areas where fossil fuel costs are extremely high. An exception to this may be endothermic chemical reactions which require a very high temperature level, not easily attainable using fossil fuels. The use of nuclear fuel for space heating appears to be even more remote because of the critical size of the fuel inventory if individual heating units are contemplated. If district heating is considered as an alternative, the same limitations apply as in the case of fossil fuels used for district heating, that is, high distribution costs of the heat values. The technical developments that will reduce costs for power generation using nuclear fuels will be applicable to space and process heating.

Motive power

Nuclear propulsion of merchant ships appears feasible, although in the present state of development the weight of the components might be greater than for conventional plants (including fuel storage) and would require higher capital cost. Nuclear propulsion of ships will become economic first for ships, such as tankers and ore carriers having long trade routes and operating at high speeds. It is claimed that with the present rapid obsolescence of our merchant ships, if nuclear power is to be used on ships in the next 20 years, the prototype units must be built immediately. If the technology is not developed in time for use in replacing the present fleet, nuclear energy could not be used for a large number of ships until the merchant fleet again required replacement.

Much greater research effort has been put into the development of means of using nuclear propulsion for aircraft because of important logistical and operational advantages for military use. It has been stated that the total operating expenses for initial nuclear aircraft will be greater than for conventional aircraft and that conventional aircraft will retain this economic advantage for a considerable period of time for planes making relatively short flights.

Nuclear propulsion for locomotives appears to be technically feasible, and much of the research on its use in aircraft and ships will be applicable to locomotives. However, severe limitations are imposed on locomotive design, since large shielding will be required for protection from radiation, with the simultaneous requirement that the weight and dimensions must be approximately that of equipment now in use. In contrast to the potential advantages of using nuclear fuel in aircraft (longer distance of travel and greater payloads) or for submarines (no air required for combustion), no comparable advantages exist for locomotives. Major technologic advances must be made before nuclear power could be seriously considered for locomotive use.

V. ECONOMICS OF COMPETITIVE FUELS FOR POWER GENERATION

The foregoing considerations indicate that for the next 20 years the greatest effect of nuclear fuel will be on the fossil fuel markets for power generation. Estimates of expanding electrical power demands for the United States have been made by a number of experts, and these estimates for 1975 are compared in table 5. The 1955 electrical power demand was approximately 550 billion kilowatt-hours, so that the minimum increase expected by 1975 is over 100 percent and the maximum nearly 400 percent.

The share that nuclear energy can expect to obtain of this increased demand for power in the next 20 years will depend largely on the economics of production of power from this source, which in turn depends on the potentials for improved technology. Table 6 indicates the average costs of 7 modern coal-burning powerplants, which require less than 9,500 British thermal units per kilowatt-hour. For these plants, fuel costs averaged 1.91 mills per kilowatt-hour, and total production expenses 2.37 mills per kilowatt-hour. The average cost per kilowatt of installed capacity for these 7 plants is $153. Depending on plant size, average costs per kilowatt for coal-burning powerplants range from $115 to $200. Table 7 shows the average cost per kilowatt of installed capacity expected in the nuclear powerplants under consideration. These costs are in the range of $230 to $450.

TABLE 5.—*United States total electric-power generation, 1975*

	Billion kilowatt-hours, 1975
Federal Power Commission	1,354
Electrical World	1,970
President's Materials Policy Commission	1,400
American Gas & Electric Service Corp	2,000

TABLE 6.—*Average values for 7 steam-electric plants burning coal requiring less than 9,500 British thermal units per kilowatt-hour* [1]

	Value	Per kilowatt-hour
Plant cost:		
Structure and improvements	$13,195,000	
Equipment	45,351,000	
Total	58,546,000	$153
Production cost:		*Mills*
Operation, labor, supervision, engineering, maintenance, operation, and supplies	$1,190,000	0.46
Fuel	4,694,000	1.91
Total	5,884,000	2.37
Installed generating capacity, megawatts		384.8
Average British thermal units per kilowatt-hour (net generation)		9,297

[1] Federal Power Commission 1954, Steam-Electric Plant Construction Cost and Annual Production Expenses.

TABLE 7.—*Anticipated costs of nuclear powerplants* [1]

Reactor type	*Cost per installed kilowatt*
Pressurized water	$230–$270
Boiling water	250–281
Sodium-cooled graphite	325
Fast breeder	450
Aqueous homogeneous	357

[1] Lane, J. A., Economics of Nuclear Power.

If nuclear fuel could be assumed to have no cost, the total savings for fuel would be only 1.91 mills per kilowatt-hour for modern plants. Offsetting this would be the increased cost of operating nuclear plants and the decreased efficiency due to the lower pressures and temperatures in the steam cycle. In addition, charges for capital costs for nuclear plants would be on the order of 1.5 to 2.5 mills per kilowatt-hour more than for conventional plants. This would seem to indicate that, under present conditions, nuclear plants would be unable to produce electricity cheaper than conventional plants even with no fuel cost. However, for conventional plants the potential reduction in costs by improved technology is relatively limited, while for nuclear plants it is very large. In the period beyond 1975, it can be expected that generation of power using nuclear energy will be on a more competitive basis. In this connection, Adm. H. G. Rickover estimated that when the third core is built for the reactor at Shippingport, Pa., in about 1965, the cost of power may be 14 mills

per kilowatt-hour, in contrast to the first core, from which power is estimated to cost 52 mills per kilowatt-hour. This is well over the costs for modern conventional plants.

Several energy experts have predicted the amount of energy to be generated by nuclear fuels by 1957 in the United States. The Panel on the Impact of the Peaceful Uses of Atomic Energy gave a range of 20 to 45 million kilowatts. Philip Sporn, of the American Gas & Electric Corp., estimated the installed capacity at not more than 20 million kilowatts. If one assumes the estimate of 20 million kilowatts of installed nuclear capacity in 1975, approximately 38 million tons of bituminous coal would be displaced, if we neglect possible displacement of oil and gas. The European installed capacity might reasonably be expected to be of the same order of magnitude.

Now it will be recalled that the best available estimates of coal required for the 1975 electric power load in the United States range from 340 million to 488 million tons. Not only is the estimated nuclear energy displacement a very modest percentage of the anticipated total requirement, it is far less than the spread of these estimates. The forecasts for total United States coal requirements for all purposes, including export, range from 819 million to 886 million tons, a closer agreement but still a broader spread than the anticipated nuclear displacement.

The obvious conclusion is that those who have to plan now for 1975 coal mining, handling, shipping, etc., can ignore the impact of nuclear energy. It will probably be 10 years before realistic estimates of this can be made, and by then it is quite possible that such nuclear energy applications as gasification of coal will be actually adding to the coal demand.

[From Nucleonics Magazine, August 1956]

WHERE REACTOR DEVELOPMENT STANDS TODAY

Excluding reactors for Pu production and aircraft propulsion, today's 45 reactors will be joined by about 127 more by 1960. New technical discoveries have made more reactor types look promising. Thus, although competitive nuclear power is still "on paper," continuing progress points toward an encouraging future

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Just how far the reactor business has progressed since the first pile went critical in December of 1942 is shown on the cover. The figures for the years 1956 through 1960 correspond to reactors now planned or being constructed, although in the case of research reactors, the numbers of reactors constructed after 1958 have to be estimated. This is because construction of all research reactors announced will be completed before that time.

The numbers do not include the 13 United States large-scale production reactors, foreign production reactors, or aircraft-propulsion reactors.

NON-UNITED STATES POWER PROGRAMS

As shown by the partial list in table 1, many countries have made a good start toward the development of nuclear power. In most cases, emphasis is on reactors fueled with natural uranium. This is partly because the United States offer to make available 20,000 kilograms of enriched uranium for foreign power reactors has not yet had an effect on announced power-reactor programs, and partly because many countries believe that it is more economical to operate with natural uranium and advantageous to remain independent of the availability of enriched fuels.

Since natural-uranium-fueled reactors are necessarily very large, the use of some enrichment considerably increases the flexibility of the reactor design from the standpoint of choice of coolant, cladding, and size of reactor. Even if the reactor requires some enrichment for the initial loading, continued operation may be possible using only natural uranium plus plutonium from spent fuel.

Russia

The Russian program is worthy of special mention. At Geneva, the first Russian nuclear powerplant was described; it uses a water-cooled graphite-moderated reactor (1). In reality, this powerplant is a pilot plant and is not claimed to be economical.

Early this year, the Soviet Union announced that it had plans to build during 1956–60 nuclear-power stations with a total capacity of 2 to 2.5 million kilowatts. I. V. Kurchatov, a leading member of the U. S. S. R. Academy of Sciences, reporting to the 20th Congress of the Communist Party in Moscow on February 22, stated, "* * * Two atomic electric stations with a total capacity of 1 million kilowatts will be built in the Urals by 1960, and near Moscow there will also be built an atomic station with a capacity of 400,000 kilowatts. In addition, up to 10 types of reactors with individual electric capacities from 50 to 200,000 kilowatts will be built by 1960, * * *." In an April talk at Harwell, Kurchatov gave more details of these plants. The program is summarized in table 1.

TABLE 1.—*Non-United States power reactor programs*

Reactor type	Power (Mw)		Cost (million dollars)	Completion date
	Heat	Elec.		
Austria		10	4	
Belgium: Pressurized water		11.5	4.6–5.7	1958
Canada: Nat. U, D_2O		20	11	1958
France:				
Air, graphite		5		1956
Two CO_2, graphite		25		1957
Norway: Nat. U, D_2O	[1] 20	0	3.5	1959
Sweden:				
Nat. U, D_2O	[1] 75			1960
Nat. U, D_2O	[1] 90			1960
Nat. U, D_2O	[2] 71	13		1961
Three		75–300		1962
Britain: [3]				
Air, graphite; Windscale [3]		0		
Stage-0: [4]				
CO_2, graphite; Calder Hall		70		1956, 1957
CO_2, graphite; Calder Hall		70		1958
CO_2, graphite; Chapel Cross		70		1958
CO_2, graphite; Chapel Cross		70		
Stage-1: [5]				
CO_2, graphite; Bradwell		150		1961
CO_2, graphite; Berkeley		150		1961
CO_2, graphite; Glasgow		150		1961
Stage-2: [6]				
Na, graphite; 3 sta		450–750		1963
Na, graphite; 6 sta		750		1965
Stage-3: [6]				
Aqueous homogeneous				
Fast breeder				
Union of Soviet Socialist Republics: [7]				
First experimental plant:				
H_2O, graphite		5		1954
First large developmental plant:				
Pressurized water, graphite		100		end 1956 [8]
Pilot plants (" up to 10^7" types): [9]				
H_2O-moderated and -cooled		70		1958–60
Graphite-moderated; H_2O-cooled	>1,000	200		1958–60
D_2O-moderated, CO_2-cooled [10]	>1,000	200		1958–60
H_2O boiling		50–70		1959–60
Homogeneous, U^{233}-Th breeder		50–70		1959–60
Graphite-moderated, Na-cooled		50–70		1959–60
Fast breeder, Na-cooled		50–70		1959–60
Three full-scale power plants in Urals:				
Two, type unspecified		500		1960
One, type unspecified		400		1960

[1] For process heat.
[2] Total of 23 reactors (some stations have 2 reactors); total installed nuclear capacity to be about 2,000 Mw.
[3] 2 reactors used for Pu production.
[4] For Pu+power.
[5] For power+byproduct Pu.
[6] Power only.
[7] Overall goal is 2,000–2,500 Mw nuclear electrical capacity by 1960.
[8] Described by D. I. Blokhintsev at Geneva conference.
[9] 2 types remain unspecified.
[10] Discussed by V. V. Vladimirsky at meeting sponsored by National Industrial Conference Board, New York, October 1955.

As in our own program, the large-scale plants use the more conventional nuclear systems and the smaller pilot plants use the advanced types of reactors. These experimental reactors will have a combined electrical output of about 1,000 megawatts, which, with the very large plants previously mentioned, will provide the Russians with an installed nuclear electrical capacity of 2,000 to 2,500 mega-

watts by 1960. Although some confusion exists concerning the electrical capacities of individual plants, indications are that capacities given in table 1 are substantially correct. This very ambitious program, though greater in numbers of electrical kilowatts than our own program, is certainly not as diversified.

Britain

The British nuclear-power program belongs in a class by itself. Drawing on experience with the graphite plutonium-production piles, the British have evolved a program of reactor construction that permits them to move ahead while the development program also proceeds. This dual-purpose route to nuclear power has been suggested as a means of expediting the United States program. However, it was not adopted in the United States due to the fact that sizable plutonium-production facilities were available already and a dual-purpose system requires essentially complete Government control. Adoption of this approach might have delayed industrial participation in our program.

The schedule for the construction of United Kingdom power reactors indicates that the installed nuclear plant capacity in the United Kingdom will be more than 2,000 megawatts of electricity by 1965.

THE UNITED STATES POWER PROGRAM

As shown in table 2, United States power reactors can be divided into three classes: (*a*) Those financed entirely by the AEC; (*b*) those financed jointly by AEC and industry, and (*c*) those financed entirely by industry.

AEC financed[1]

In most of the five cases listed, each type includes a reactor, experiment and a prototype reactor, the low-power versions serving to test the nuclear characteristics of the reactor; the high-power versions test engineering characteristics.

Los Alamos

An AEC-sponsored power-reactor program that involves more venturesome types of reactors is not shown in the table. At Los Alamos, three experimental power reactors are being developed, one of which, the LAPRE–1, has already been operated. This reactor is fueled with a solution of enriched UO_2 in aqueous phosphoric acid. Because of the highly corrosive nature of the solution, all equipment in contact with it has to be gold plated or made of platinum. In assembling the LAPRE–1, the gold plating on a portion of the cooling coils was damaged and this portion corroded through in about 5 hours. But the Los Alamos group feels that this system can be made reliable and is going ahead with a new set of cooling coils. The second test is scheduled for this June (*2*).

LAPRE–2 uses a comparable fuel system, but the reactor operates with natural circulation rather than forced circulation used in LAPRE–1. Most of the components are completed and final assembly is expected to be accomplished late this summer.

A third reactor, the LAMPRE, is being built to test the concept of using a molten plutonium allow as the fuel. A 1-megawatt pilot model will be completed in 1959 and the design of 50 to 100-megawatt-scale reactors is being studied. High temperatures will be possible with this system and breeding using such a fuel is potentially possible.

Joint AEC-industry financed

For the experimental and prototype reactors being developed jointly by industry and AEC, it will be noted that, in some cases, industry is bearing the major share of the costs and, in other cases, most of the cost is financed by AEC (*3*).

Second round

An AEC invitation for industry to consider a second round of power-demonstration reactors involving small-scale plants resulted in seven proposals, each using a different type of reactor. The two proposals made by the Elk River Association and the Wolverine Electric Cooperative have been "approved in principle" by AEC. Contracts for AEC assistance, which involves 75 percent of the costs for design, development, and construction of the facilities, will be contingent on approval of the Rural Electrification Administration loans requested by the cooperatives. The remaining proposals are still being evaluated by the AEC staff.

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[1] SRE and OMRE are not included here since their construction is financed partly by industry.

Industry financed

Permits for the construction of three of these reactors were issued on May 4 and May 15 to the Consolidated Edison Co., the Commonwealth Edison Co. and the General Electric Co. Each construction permit allocates special nuclear material to be made available over a 40-year period.

The amount required for the Consolidated Edison reactor for this period is estimated to be 5,700 kg. U^{235}, and for the Commonwealth reactor, 8,300 kg. U^{235}. Annual requirements for the Consolidated reactor amount to 155 kg. U^{235}. However, 140 kg. o f U^{235} are produced after equilibrium is reached in about two years of operation, by neutron capture in the thorium, of which 62 kg. are consumed. The Commonwealth reactor uses 225 kg. U^{235}/year during steady-state operation, to be reached about four years after startup. Completion dates of September 30 and October 1, 1960, are stipulated in the permits.

TABLE 2.—*United States power-reactor programs*

Reactor type	Power (Mw)		Cost [1] (million dollars)	Completion date	Contractors
	Heat	Electric			
AEC-financed projects:					
Boiling water:					
Borax-3	15	2-3	$0.6	1955	ANL.
EBWR	20	5	3.6	1956	ANL, Sargent & Lundy.
Pressurized water:					
APPR	10	[2] 2	2.1	1957	ORNL, Alco.
ALPR	−1	−0.2			ANL.
Fast breeder:					
EBR-1	1.4	0.17	2.7	1951	ANL.
EBR-2	62.5	17.5	15.3	1958	ANL.
Aqueous homogeneous:					
HRE	1.0	0.15	1.1	1952	ORNL.
HRT	5-10	[2] 1-2	−3	1956	ORNL.
Liquid-metal fueled:					
LMFRE	5-10			1959	BNL, Babcock & Wilcox.
oint AEC-industry-financed projects:					
Pressurized water (PWR).	264	60	[3] 15.5; —: 32.2;59.6	1957	Westinghouse, Duquesne.
Sodium graphite (SRE)	20	7.5	1.8; 2.1: 4.1; 6.5	1956	North American Aviation.
Fast breeder (FBR)	300	100	45; 9: 4.5;	1960	Detroit Edison & Power Reactor Development Co.
Sodium graphite (SGR)	238	75	16.0; —: 8.3; 2.2	1959	CPPD of Nebraska; Atomics International (NAA).
Pressurized water	500	134	34.5; —: —; 5	1959	Yankee Atomic Electric, Westinghouse, Stone & Webster.
Organic moderated (OMRE).	16	0	—; 0.7: 0.8; 0.4	1957	Atomics International (NAA).
Small-scale jointly financed projects (2d round, power demonstration program):[4]					
Sodium-D_2O (SDR)		10	7.4	1961	Chugach Electric, Anchorage, Alaska; NDA.
Closed-cycle N_2-cooled		15	6.4	1960	City of Holyoke, Mass.; Ford Instrument Co.
LMFR		25-40	23.6	1960	City of Orlando, Fla.;—
OMR		12.5	5.3	1960	City of Piqua, Ohio; Atomics International.
BWR		22	6.2	1960	RCPA, Elk River, Minn.; AMF Atomics.
PWR		2	1.6	1959	University of Florida; Alco.
Aqueous homogeneous		10	3.6	1599	Wolverine Electric, Hersey, Mich.; Foster-Wheeler.
Privately-financed projects:					
Pressurized-water Th-U converter.	500	[5] 140	55	1959	Consolidated Edison of N. Y.; Babcock & Wilcox.
Dual-cycle boiling water	670	180	45	1960	Commonwealth Edison of Chicago; GE, Bechtel.
Aqueous homogeneous		150	−50	1962	Pennsylvania Power & Light; Westinghouse.
Boiling water		5-10	3-4	1956	Pacific Gas & Electric; GE.
Bismuth graphite (BGR).		200	50	1962	Florida power companies; Babcock & Wilcox, Allis-Chalmers.

[1] Does not include research and development costs unless otherwise specified.
[2] Capability.
[3] 1st 2 numbers are portions borne by industry; second two numbers are costs borne by AEC in each case, figure at left is capital cost and figure on right is research and development charges.
[4] Cost figures do not include $27-million for research and development.
[5] Plus 96 Mw added via heat from an oil-fired superheater.

The pilot model of the GE boiling-water reactor will be built at GE's new nuclear laboratory near Livermore. This plant initially will have a generating capacity of 3,000 kw (electric) and an ultimate capacity of 10,000 kw, and use a net of 29 kg U^{235} over a 7-year period. The remaining two reactor projects are still in the preliminary stage and depend on development work now underway.

PROGRAM DEVELOPMENTS

Five years ago a number of feasibility and economic studies were carried out by the national laboratories, AEC, and various industrial groups to evaluate reactor systems for plutonium production and for power production. The aim was to select the most promising systems and streamline the reactor development program along these channels.

Five systems were chosen for further extensive development. These systems were (*a*) boiling water, (*b*) pressurized water, (*c*) sodium graphite, (*d*) aqueous homogeneous, and (*e*) fast breeders. In April AEC announced that it had signed a contract with Atomics International (NAA) for the construction and operation of an organic-moderated reactor experiment (OMRE) in Idaho. This experiment is designed to establish the technical feasibility of using the hdyrocarbon diphenyl as moderator and coolant. (It is interesting to note that the use of diphenyl as a coolant was proposed in 1942 for the first Pu-production reactor.)

In May AEC announced that negotiations with Babcock & Wilcox Co. are proceeding for the construction of a liquid-metal-fueled reactor experiment. In June the Commission announced a gas-cooled reactor with a closed-cycle gas turbine as the seventh system for its program of research and development aimed at the achivement of economic electrical power from nuclear fuels. Other types also being considered are (*a*) sodium-cooled D_2O-moderated, (*b*) liquid-metal fast breeders, and (*c*) dilute-solution homogeneous U^{235} burners.

If one adds to these systems power-reactor types being developed and built in foreign countries, and reactors for submarine propulsion, there are more than 20 nuclear systems that appear to be promising for economic power production. These are listed in Table 3 according to type of moderator.

It is evident that the large number of promising power-reactor types is due more to the wide range of possible coolants than to the choice of moderator. Most thermal reactors being considered use graphite, H_2O, or D_2O for moderation. But thirteen different coolants are used in proposed systems.

If these coolants are arranged in order of increased difficulty of handling and other problems, this same order is roughly representative of the technical feasibility of the various type of reactors. Thus the solution of problems associated with the various coolants is necessary to the success of a given type of reactor. The list of coolants arranged in order of difficulty of handling is given in table 4, along with the types of reactors associated with each coolant. At the risk of criticism from those developing coolants near the bottom of the list, the estimated dates of established technical feasibility are also shown. These dates are based on operation dates of engineering-test prototypes or larger-scale reactors.

The performance of each coolant and associated reactor type, measured in terms of heat-removal possibilities and corresponding economic advantages, is in many cases inversely proportional to technical feasibility. In other words, as one goes down the list, problems become more difficult, but prospects for low-cost power increase.

TECHNICAL DEVELOPMENTS

A number of technical "breakthroughs" have been made that improve the economic feasibility of various reactor types.

H_2O reactors

Highly enriched reactors using ordinary water as the coolant and moderator have emerged as a most promising type for small plants and transportable (package) reactors. The advantage of this system is due mainly to the compactness of H_2O moderated cores and the relative simplicity of H_2O-cooling and steam-generation systems. The main problem is the design of fuel elements and the difficulty of obtaining long burnup cycles.

Fuel elements.—Fuel-element designs in existing reactors are almost exclusively of the MTR type, that is, slightly curved plates mounted in a rectangular-box subassembly. For high-temperature operation, the aluminum cladding used in the MTR must be replaced with either Zircaloy-2 or stainless steel, and the uranium-aluminum fuel alloy replaced with either an alloy or an oxide dispersion of uranium in Zircaloy-2 or stainless steel. Fabrication costs of such fuel elements, combined with relatively short burnup cycles result in fuel costs of about 20 mills kwg or greater. Thus, reactors using these fuel elements probably will not be applicable for civilian powerplants.

Fuel-element development work to simplify fabrication and increase operating cycles is in progress, with the trend toward tubular fuel elements filled with unbonded, slightly enriched, UO_2 compressed pellets, with the tubes mounted in a typical box subassembly. Considerable reductions in fuel costs will result if these fuel elements are successful.

Improving aluminum corrosion resistance.—Tests on the improvement of the corrosion resistance of aluminum to high-purity water have been underway for several years. This is important to the development of water-moderated power reactors in that the use of aluminum as a cladding material offers the possibility of greatly reduced fuel costs. Commercial 2S aluminum is reasonably resistant to water corrosion; however, most aluminum alloys oxidize and disintegrate rapidly at temperatures of 250–375° C., necessary for power production.

An alloy-development program at Argonne National Laboratory has indicated that additions of nickel up to 1 percent or so, and other materials such as copper and titanium in small amounts, markedly reduce the tendency for 2S aluminum to disintegrate. Tests at temperatures of about 290° C., indicate corrosion rates of less than 2 mils/yr with 2S Al + 0.9 percent Ni, Al + 1 percent Ni, 0.2 percent Ti, and Al + 1 percent Ni, 0.3 percent Fe, 0.15 percent Mn in contact with distilled water. With 2S Al + 0.9 percent Ni in contact with acidified water (H_2SO_4, pH = 3.5) at 290° C, the measured corrosion rate was 1 mil/yr. Limited tests under irradiation indicate lower corrosion rates than obtainable in loop tests. The presence of hydrogen results in low corrosion rates.

Casting fuel elements.—Another fuel-element development program is being carried on at Argonne in connection with the fast-breeder program. A method of uranium casting of rods in precision molds is being perfected to develop a fuel element that can be made by completely remote operations. Tests indicate that 100 or more such elements can be cast in one operation.

D_2O reactors.

With regard to D_2O-moderated reactors, the most significant development is the increased availability of heavy water at the relatively low cost of $28/lb. At this price, power costs due to D_2O inventories and losses in well-designed reactors are very low. Thus, the additional neutron economy obtainable with D_2O can be exploited much better.

Aqueous homogeneous reactors.

Aqueous-homogeneous reactors have long been plagued with the problem of separating and recombining the gases produced in the reactor from the radiation-induced decomposition of water. In the HRE, for example, at 1,000 kw and 1,000 psi operation, gas was formed at a rate of 10.3 ft^3/min at STP. A method of controlling this gas production through the use of solution catalysts has been announced recently (*4*). The addition of about 0.05 moles of copper sulfate to the HRE was found to completely suppress gas production at these operating conditions. This corresponds to a molar ratio of Cu/U of about 0.3. One-third of this copper concentration is sufficient to recombine 50 percent of the gas. The use of copper in solution also is effective in preventing high peroxide concentrations that may lead to precipitation of the uranium from solution (*5*). For example, at 100° C. power densities above 0.5 kw/l cause precipitation without copper. With copper and iron, power densities of about 10 kw/l can be reached without precipitation occurring.

TABLE 3.—*Power reactor types.*

Reactor designation	*Designers*
H_2O moderated:	
Submarine thermal (STR)	ANL, Westinghouse, G. E.
Army package power (APPR)	ORNL, Alco
Pressurized water (PWR)	Westinghouse, Yankee Atomic
Pressurized water Th-U converter	Babcock & Wilcox
Boiling water (EBWR, etc.)	ANL, AMF, G.E., Norway
Dual-cycle boiling water	General Electric
Acqueos U^{235} burner (HRE)	ORNL
D_2O moderated:	
H_2O cooled (NRX)	Canada
D_2O cooled (NPD)	Canadian General Electric
CO_2 cooled	USSR, Sweden
Sodium cooled	NDA, Foster Wheeler
Aqueous homogeneous (HRT, etc.)	ORNL, Westinghouse, Los Alamos
Graphite moderated:	
Air cooled (G–1)	France
CO_2 cooled (Calder Hall, G–2)	England, France
H_2O cooled	GE (Hanford), USSR
Sodium cooled (SRE, SGR)	NAA
Bismuth cooled	B & W, Florida power groups
Liquid-metal fueled (LFMR)	B & W, BNL
Nitrogen-cooled closed-cycle gas turbine [1]	Ford Instrument
Organic moderated:	
Diphenyl cooled (OMRE)	NAA
Beryllium moderated:	
Submarine intermediate	GE (KAPL)
Unmoderated:	
Fast power breeder	ANL, APDA, Los Alamos, Britain
Molten plutonium alloy	Los Alamos

[1] Other moderators being considered.

TABLE 4.—*Technical feasibility of power-reactor types*

Coolant	Moderator	Reactor type	Estimated date of established technical feasibility
Air	Graphite	G–1	1955
CO_2	do	Calder Hall	1956
H_2O	Graphite, H_2O	APS–1, PWR, STR	1955–57
D_2O	D_2O	BWR, NPD	1955–56
Dilute UO_2SO_4 sol'n	H_2O	HRE	1956
Na	Graphite	SRE	1956
NaK, Na	None	EBR	1958
Conc. UO_2SO_4 sol'n	D_2O	HRT	1956
ThO_2 slurries	D_2O	TBR	1960
Bi, U+Bi	Graphite	LMFR	1959
Diphenyl	Diphenyl	OMRE	1957
Phosphoric acid	H_2O	LAPRE–1	1956
Molten Pu alloy	None	LAMPRE	1960

Slurry handling.—The other homogeneous-reactor development problem receiving considerable attention in the laboratories is that of slurry handling. Solution of this problem is necessary, since the use of slurries is essential to most types of homogeneous reactors.

The major difficulties with uranium and thorium oxides have been found to arise from settling and caking rather than corrosion and erosion. With regard to this latter aspect, a stainless-steel high-pressure loop was operated 15,000 hr with uranium- and thorium-oxide suspensions without encountering excessive corrision rates. However, in a second loop, severe caking of thorium oxide occurred after a few hundred hours. This cake had to be removed with a chisel. Research on cake formation continues; however, the same loop has been operated subsequently for more than 2,000 hr with 1,000 gm/l ThO_2 at 300° C. and 2,000

psi without encountering cake formation. It is believed that continuity of operation is possible through more careful control of slurry preparation and loop operating temperatures. A full-scale mockup of the HRT slurry-blanket system is just now starting to operate with slurry to obtain further information on the behavior of ThO_2 suspensions.

Graphite reactors

Technical developments in graphite-moderated reactors are mostly related to the heat-transfer and -removal problem in an attempt to improve the performance of this type of reactor. The good performance of the Calder Hall reactors and the advanced U. K. Civil Stage-1 reactors is, for the most part, due to the development of a unique finned-tube fuel element that gives high heat transfer, even with CO_2 as the collant.

Reactors with gas turbines

Interest in a closed-cycle gas-turbine nuclear plant is increasing because of the advantages of such a system as a mobile or transportable unit. In such a gas-turbine plant, gases heated by the reactor are expanded directly through the turbine. Advantages include low weight and size for the power produced and high thermal efficiencies. Disadvantages are due to the poor heat-transfer and heat-transport characteristics of gas as a coolant. These disadvantages, which normally lead to higher capital costs and higher fuel costs, may be offset by the high thermal efficiencies or may be relatively unimportant for particular applications. The Army is especially interested in gas-turbine plants for remote uses because of their portability and suitability for arid locations.

Organic-moderated reactors

Plans to go ahead with the organic-moderated-reactor experiment are indicative of the success of laboratory and inpile experiments with radiation decomposition of diphenyl and terphenyl. The use of organic compounds such as these has several potential advantages, among which are low induced radioactivity, low corrosion of fuel elements, and low vapor pressures, which make reasonably high-temperature systems possible.

These advantages combine to ease the containment problem to the point where normal power-plant construction may be adequate, rather than pressuretight spheres or underground tanks.

Liquid-metal-fuel reactors

The liquid-metal-fueled reactor concept is another high-temperature low-pressure system that shows increasing promise of low-cost power. The inherent difficulties associated with a bismuth-cooled system, such as low uranium and thorium solubilities, mass-transfer problems, and fission-product removal, which a few years ago made this system less attractive than others, now appear to have been essentially solved by the research and development program at Brookhaven. Loops have been operated at conditions closely simulating those in a reactor for 3 years under varying conditions with only small mass-transfer depositions being encountered (*6*). Complete removal of the oxygen from the bismuth and use of zirconium as an inhibitor have been found to aid in this regard. A low-flux fission-product-removal loop operated in the Brookhaven pile indicates the feasibility of the K-Na-Mg chloride fused-salt-extraction process for fission-product removal from bismuth.

POWER COSTS

So much has been said and written concerning nuclear-power economics that most people are at present adequately confused about the prospects for low-cost nuclear power. In general, it can be said that no single reactor type has yet emerged as the most promising system for the production of low-cost power. At the present time, both the capital costs of nuclear plants and nuclear fuel costs are high compared to conventional plants. This is shown in figure 1, in which the capital costs of all existing or planned United States nuclear plants are compared with coal-fired plants and diesel plants (*7*). Costs of prototype and test reactors are included, although it is realized that the experimental nature of such reactors normally results in unusually high costs. It is evident that the difference in initial plant cost is much greater for the small plants than for the very large.

Corresponding power costs are compared in figure 2. Here again nuclear power costs are high compared to conventional power costs. However, there is some evidence that nuclear power costs are on their way down and, in some cases, projected costs are competitive with power costs from coal-fired plants.

(This article is based on a paper presented before the second annual meeting of the American Nuclear Society, June 6–8, 1956, Chicago, Ill.)

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Power-Reactor nomenclature

Adam	Swedish Power Reactor (nat. U, D_2O)
ALPR	Argonne Low-Power Reactor (boiling water)
APPR	Army Package Power Reactor (pressurized water)
APS–1	U. S. S. R. Atomic Power Station (graphite, H_2O)
ARE	ORNL Aircraft-Reactor Experiment
BGR	Bismuth Graphite Reactor
BORAX–3	Boiling-Water-Reactor Experiment
BWR	Boiling-Water Reactor (dual-cycle)
Calder Hall	U. K. Dual-Purpose Reactor (graphite, CO_2)
CDR	CO_2 D_2O Reactor
CGR	CO_2 Graphite Reactor
EBR–1, EBR–2	Experimental Breeder Reactors (fast)
EBWR	Experimental Boiling Water Reactor
EL–3	French Enriched–U, D_2O Research Reactor
Eve	Swedish Power Reactor (nat. U, D_2O)
FBR	Fast Breeder Reactor
G–1, G–2	French Power Reactors (air, graphite; CO_2, graphite)
HR	Homogeneous Reactor
HRE	Homogeneous-Reactor Experiment (UO_2SO_4, H_2O)
HRT	Homogeneous-Reactor Test (UO_2SO_4, D_2O)
LAMPRE	Los Alamos Molten-Pu-Alloy Reactor Experiment
LAPRE–1, LAPRE–2	Los Alamos Power-Reactor Experiments ($UO_2H_3PO_4$)
LMFR	Liquid-Metal-Fueled Reactor (U + Bi)
LSR	Large Ship Reactor (pressurized H_2O)
NPD	Canadian Nuclear Power Demonstration (U + D_2O)
OMRE	Organic-Moderated-Reactor Experimental (diphenyl)
PAR	Pennsylvania Advanced Reactor (aqueous homogeneous)
PWGR	Pressurized Water Graphite Reactor
PWR	Pressurized Water Reactor
R–3a, R–3b	Sweden Power Reactors (nat. U, D_2O)
SAR	Submarine Advanced Reactor (pressurized H_2O)
SDR	Sodium D_2O Reactor
SFR	Submarine Fleet Reactor
SGR	Sodium Graphite Reactor
SIR–A, SIR–B	Submarine Intermediate Reactors
SRE	Sodium Reactor Experiment (Na, graphite)
STR–1, STR–2	Submarine Thermal Reactors (pressurized H_2O)

The Research-Reactor Picture

GRAPHITE PILES

These have been the "workhorses" of the isotope-production industry. There has been a trend away from these reactors in recent years because of their inherently high cost and the difficulty of obtaining high neutron fluxes. Only one of these reactors, the Belgium research reactor at Mol, has been built since 1950. However, an uncooled graphite exponential pile, fuel with natural-uranium rods, is an excellent, safe, and economical student-training device.

D_2O REACTORS

Natural-uranium-fueled-D_2O-moderated reactors have found particular favor in countries that wish to be independent of the availability of enriched uranium. In these reactors, high neutron fluxes can be obtained, but at a cost somewhat higher per unit of flux than in the research reactors fueled with enriched uranium (8). Thus, the construction of these reactors has been limited; since 1950 only five have been built or planned, all outside the United States.

The advantage of using enriched fuels to obtain high termal-neutron fluxes at relatively low cost is now generally accepted and 90 percent of all research reactors built or planned since 1950 use enriched fuel.

H_2O VERSUS D_2O

The controversy concerning the relative merits of light-water and heavy-water U^{235} fueled reactors has existed for a number of years. On the basis of numbers of reactors built or planned, the proponents of light-water reactors seem to have the upper hand. But there is no evidence that reactors of the CP–5 or Dido type will not continue to play an important role in research-reactor programs. Because of the availability and relatively low cost of D_2O at the present time, it is possible that more groups will select this reactor type. Because of the need for research reactors with the smallest fuel loading, foreign countries may favor low-flux D_2O-moderated systems.

SWIMMING-POOL AND TANK-TYPE REACTORS

Swimming-pool and tank-type reactors are here distinguished by those that operate at power levels below 200 kw., and thus require no forced cooling, and those that require such a system. It is not certain that 200 kw. is the proper power level at which to make such a distinction, but open swimming-pool reactors normally do not operate above 100 to 200 kw. Above this point, there is likely to be a radiation problem due to the N^{16} activity of the water. Although a forced-circulation cooling system is not necessary at even 1,000 kw. for temporary heat removal, a small cooling system normally is used above 200 kw. for continuous cooling and to keep the N^{16} activity away from personnel.

Through usage, the term "swimming pool" has been applied to many reactors that are really tank-type reactors rather than open pools. Disregarding these differences, 32 reactors of the H_2O U^{235} + Al-plate-type fuel-element variety will be operating in the not-too-distant future, with the majority striving for the higher fluxes obtainable in a tank-type reactor with a forced-cooling system.

WATER-BOILER REACTORS

Units of this type, fueled with a light-water solution of U^{235} as sulfate or nitrate, seemed a few years back to be promising competitors to the swimming-pool and tank-type reactors. Recent indications are that water boilers will find only limited use as research reactors. There are two reasons for this. First, water boilers cannot operate at average neutron fluxes above 3×10^{12} n/cm^2 sec, unless the system is pressurized so that the uranium-solution temperature can be raised above 100° C. This is because at these fluxes at temperatures lower than 100° C., the uranium precipitates as peroxide even when the solution contains an iron and copper catalyst (5). The second problem likely to be encountered in water boiler reactors is that of possible corrosion of the reactor tank and subsequent leakage of the highly radioactive uranium solution. Both of these difficulties have been encountered in the North Carolina State College reactor, which has been out of operation more than a year waiting for a replacement tank (9).

Operation of an aqueous-solution reactor, even a water boiler, requires very highly trained technical personnel, experienced and familiar with the chemical and nuclear characteristics of such a system. Because of this, the use of water boilers will find only limited application. My recommendation to those planning to build and operate water boilers—"Have plenty of chemists!"

[From Nucleonics, December 1956]

WHY BRITISH CLAIM LEAD IN NUCLEAR POWER

CALDER IS GIVING US THE LEAD

"The Calder Hall reactor is giving us the initial lead in the use of nuclear power and we shall be able to retain that advantage for at least a decade by improvements in this type of reactor."

It was with this bold statement that Sir Christopher Hinton, director of the Industrial Group United Kingdom Atomic Energy Authority, set the stage at the opening of the Calder Hall symposium in London, November 22. He was followed by many speakers, from Government and industry, who underscored what he said. The total picture was a combination of expressions of satisfaction on a hard job well done, forthright statements about the preeminent position accruing to the British as a result of Calder, and an emphatic exposition of why Calder made sense.

THE SYMPOSIUM

These were the overtones felt at the meeting. But the heart of the conference was a very detailed presentation of engineering information on the station itself. Never has there been—even at Geneva—as comprehensive a release of information on any one reactor.

The British wisely waited until the plant was in operation and then they told all—or almost all. The governmental and industrial scientists and engineers who played key roles in Calder told their technical stories, stories that were related from the early beginnings of design thinking right up to the operating product.

WHAT'S AHEAD

This points to another basic characteristic of the meeting. It was, in a sense, a post mortem on Calder, a plant that is already obsolescent in many ways—a plant whose basic purpose is military, to produce plutonium. This reactor, designed by the AEA, has been made obsolete by the proposals submitted October 1 to the Central Electricity Authority by British firms.

The bulk of the audience at Westminster's Central Hall was actually looking more for more advanced design information on Calder, particularly on plants optimized for power production. But this wasn't forthcoming, because, although the winning contractors have already been selected, details on the industrial designs are being withheld until contracts are actually awarded.

Perhaps most disappointed about the lack of more advanced information were representatives from some of the many foreign nations who were present. They were quite specifically seeking to determine how good Calder could be made, but only got generalizations.

It must be emphasized, however, that, although specifics on the potential of Calder-type reactors were not gone into in any detail, there ran through the meeting the general feeling that much more remains to be done with such plants than has yet been achieved at this early point. In fact, there is very substantial evidence that the British are tying their nuclear future even more to gas-cooled reactors now than they planned to.

One big advantage that the Calder-type unit has is that it uses natural uranium. It is this that has tremendous appeal to many foreign nations who say quite bluntly that they don't want to be tied to United States enriched uranium. And it is this that points up one of the biggest lessons to the United States—the need to push natural-uranium plants to bolster our competitive position abroad.

The British Government is taking a new look at its nuclear power program. The reason for this was made quite clear last month as Britain's nuclear scientists and engineers gathered for the Calder Hall symposium. Even as they met in Westminster's drafty Central Hall, British troops were standing guard over a

now-useless Suez Canal through which more than 17 million tons of Middle East oil had moved to the United Kingdom this year.

The Middle East crisis is forcing the Eden government into a critical reappraisal of its planning for atomic power. Previously, the thinking on Britain's nuclear program had been oriented to the need to meet the annual shortage of 20 million tons of coal expected to develop by 1975. Now, it is seen as a means of release from her frightening dependence on Middle East oil.

Britain's Minister of Fuel and Power told Parliament in the same week the symposium met that the Government is going to press ahead "at the fastest possible pace" with development of atomic energy. He promised the House of Commons a full statement on the subject before the end of the year.

That statement may well find Britain doubling the atomic energy requirements outlined in its white paper program of February 1955. Nevertheless it is not considered likely that this will involve any significant increase in the number of nuclear power stations proposed in the white paper. It is evident that the goal can be raised by two other methods:

Official recognition of the technical improvements that already are expected to increase the output of the 12 stations in the first stage of the program 2 to 3 times above that estimated in the white paper.

Speedup of nuclear power expansion by a "modest crash program" calling for completion of plants each year rather than every 18 months.

Thus, even in the face of its Middle East crisis, Britain can be expected to continue the cautious, conservative approach to its nuclear energy needs that has marked the program to date. The step-by-step attack on the development of nuclear power reactors is not likely to be abandoned.

"We cannot afford to push the industry into a faster rate of expansion than it can safely absorb," one Government official states. Under these conditions, Britons are more confident than ever that their decision to go ahead with a power program based on the gas-cooled graphite-moderated reactors of the Calder type has been the correct one.

BRITISH PROGRAM

The British program is the result of a three-way partnership between the United Kingdom Atomic Energy Authority, the Central Electricity Authority, and the Fuel and Power Ministry.

The British power program

	Output (Mw) net	Completion date
Atomic Energy Authority stations (optimized for Pu; power a byproduct):		
Calder Hall A	150	1956–57
Calder Hall B	150	1958
Chapel Cross A	150	1958
Chapel Cross B	150	1959
Central Electricity Authority stations ((the white paper program) optimized for power; Pu a byproduct):		
Stage 1:		
Berkeley, Gloucestershire	250–300	1960
Gradwell, Essex	250–300	1960
Inkley Point, Somerset	300–400	1961
(North Wales?)	300–400	1961
Stage 2: 4 stations	>400	1963
Stage 3: 4 stations	>400	1965
South of Scotland Electricity Board (outside the white paper program, but also for power first):		
Hunterston, Ayrshire	250–300	1960

NOTE.—Each of these stations will consist of 2 reactors, except those in stage 2 and stage 3, by which time it is expected a single reactor of advanced design will yield the large output shown.

It must be remembered that the Calder Hall station is not one of the stations in the Central Electricity Authority's nuclear power program—the white paper program. Although it is the prototype for the CEA stations, Calder Hall's estimated cost of $56 million was borne entirely by the Government through the Atomic Energy Authority. The primary product of Calder Hall is plutonium; electricity is a byproduct.

CEA'S 10-YEAR PLAN

The 12 nuclear-power stations that the CEA is planning in its $980 million program over the next 10 years will be designed for maximum power output. The decision on the bids for the first two CEA stations has been reached and will be announced shortly, together with the award for the first station for the South of Scotland Electricity Board. These stations, basically the same physical size and cost as Calder Hall, will have an output in the 200–300 Mw category, thanks to technical improvements not anticipated at the time the white paper was drawn up. At least 8 of the 12 nuclear-power stations the CEA will build in the first 10 years of its 20-year program will be based on the Calder Hall type.

Construction of the first two CEA stations is expected to start in early 1957, aiming at operation in 1960. The construction of the next two stations in the program was to start 18 months after this, in mid-1958. Target date for these two stations may now be advanced to early 1958.

The white paper calls for an additional four stations to be started in 1960 and another four 18 months after that. These last four are to be more advanced reactors than the Calder Hall type. The decision as to just what type has yet to be made.

STAGE 2 OF PLAN

For stage 2 of the program, Harwell and the Industrial Group of the AEA at Risley have been carrying out feasibility studies and research and development on two liquid-cooled systems requiring enriched fuel: pressurized water and sodium graphite. In April 1956, the AEA said, "Present information suggests that the choice will probably fall on the sodium graphite system." After that choice, expected to have been made by this time, the next step was to have been the building of an experimental reactor.

AN ABOUT-FACE

But now thinking on the sodium graphite reactor has changed radically in the United Kingdom. One key official put it to Nucleonics this way: "Except for a very few people here, everyone is opposed to putting up such a plant."

And so the next 6 months will be spent taking a hard look at other kinds of systems. Some urgency is given to making a decision by next June because at that time a large design team will become free of other responsibilities in the Government's nuclear program.

Meanwhile, a hard push is being put on developing a pressurized water reactor for ship propulsion. However, this type is not being thought of for civilian use because of its requirement for enriched uranium, in very short supply in the United Kingdom and likely to remain expensive for some time.

In the same connection, plutonium will not be available in quantity from the Windscale and Calder Hill reactors until about 1970. Thus serious consideration for its use probably will not take place until the early 1960's.

As far as stage 3 reactors are concerned, Britain has been looking at four basic systems: fast (experimental plant under construction at Dounreay), aqueous homogeneous, liquid metal fuel, and high-temperature gas. In addition to the sizable group working on Dounreay, there is a team of 70 technicians tackling the homogeneous idea at Harwell.

GAS-COOLED STILL FAVORED

But the one thing that is quite evident is that although the British are examining other reactor types quite carefully, they keep coming back to the gas-cooled reactor with the conviction that they still have a great deal to wring out of it. They are partly moved toward this thought by the feeling that the technology for liquid reactors is quite complex and a bit beyond what they have men for right now.

Despite this skepticism, the British feel their long-range program must be built on liquid reactors. But Sir Christopher Hinton, in his paper before the symposium, most certainly did not rule out a long future for the gas-cooled Calder Hall type.

"In my view," he said, "the merits of the Calder Hall type of reactor and the potential improvements which can be made in its design are such that plants of this type will still be built 25 years from now.

"In the second half of that 25-year period, however, it will be replaced in certain land-based applications by reactors of higher rating and in the very long term it will, for most purposes, be superseded by such reactors," he added.

Hinton said reduction in weight per horsepower beyond a certain point will not be possible with the use of gaseous coolants. To advance beyond that point, he stated, higher ratings must be reached which can only be achieved by the use of liquid coolants. Use of these liquid coolants at present is not industrially practical, he added, but warned that this should not stand in the way of development of such reactors.

LOOKING TO FUTURE

The June decision will have a strong influence on the type of reactors selected for the second decade of the British power program, the 1965–75 period. The white paper does not commit itself to any specific number or type of station after 1965.

The increasing output of the nuclear stations in itself would force a Government reappraisal of the program, even without the added urgency of the Middle East crisis. It is estimated that Britain will need at least 60,000 Mw total installed generating capacity by 1975. The white paper predicted that nuclear power stations might supply as much as 15,000 Mw of this. With the rating increases now anticipated, it is apparent that the nuclear stations might be able to supply as much as 30,000 Mw, half of that needed.

This development alone would force a new evaluation of the relationship between nuclear stations, coal-fired stations and oil-fired stations. Some Ministry of Fuel and Power officials now believe all new stations built after 1968 will be nuclear stations.

The white paper anticipates the nuclear output of electricity will ease the strain on Britain's hard-pressed coal industry. But the increases now being discussed are of a magnitude actually to threaten the coal industry, particularly since there is a preference for oil when available. This could strengthen the Government's research program for converting coal into gas and oil, a move already indicated by the Suez crisis.

OTHER ECONOMIC EFFECTS

There are other ways in which the increasing impact of the nuclear program will affect the British economy. Past planning has envisaged the nuclear stations taking the base load, with coal- and oil-fired stations being pressed into service for peak loads. Installation of a larger nuclear capacity may give added impetus to incresing its use in off-peak hours, since it will further decrease its cost, providing extremely cheap base load electricity. (It is, of course, undesirable to shut down a nuclear station when the load falls, as can more easily be done with coal and oil stations.)

One official at the Ministry of Fuel and Power believes this could lead to low night tariffs, offering a million btu's for as little as 70 cents. Use of stored heat and stored steam could then become an important factor for industry, with low night tariffs encouraging a spread of peak loads. There would also be a tremendous advantage in increased use of pumped-storage stations, combining cheap nuclear power with cheap hydroelectric power.

The quickening pace of nuclear development therefore carries an import for all of Britain's economy that no one yet has had time to assess fully.

OIL THREATENED

Realization of the threat to oil—Britain depends on the Middle East for 75 percent of its oil—has made nuclear development even more of a necessity. Sir Claude Gibb of C. A. Parsons & Co., Ltd., brought this out strongly at the symposium when he declared: "We must make ourselves independent of minor despots and their whims."

He asserted that the techniques are at hand and that British industry is ready to tackle the job. But it will take more than just willingness on the part of the firms engaged in nuclear work. Gibb put it quite flatly: "Only the government of the day can decide the rate at which we exploit our lead in nuclear power."

Steel already is in short supply in Britain and is barely sufficient to support the atomic program as it is now laid down. If that program is to be stepped up, steel becomes a major problem. To make matters worse, any cutoff of

supplies from the Middle East will have its effect on steel output. The steel industry is the biggest user of fuel oil in Britain. Some two-fifths of the industry's output of crude steel is produced in oil-fired furnaces. Even with no more than the present drop in oil supplies to Britain, the nation faces a loss of three-fourths million tons of steel.

NEED FOR PLANNING

Some far-sighted government planning across all of industry will be required in order to step up the British atomic energy program, even if additional stations are not called for.

British industry came belatedly into the nation's atomic planning. Initially, atomic establishments were built to designs prepared in the Ministry of Supply and Ministry of Works. When completed, the Ministry of Supply provided the operating staff.

The Atomic Energy Authority admits frankly: "The creation of the country's first atomic-energy facilities provided little opportunity to industry to acquire practical experience of the techniques of this new field."

But when the Central Electricity Authority's nuclear power program was announced early last year, the government made it plain that private industry, not the Atomic Energy Authority, would design and build the stations. The AEA announced that dissemination of information to industry was regarded as one of its prime responsibilities. One method through which this is done is the reactor school set up at Harwell to train industry representatives in construction and operation of nuclear reactors.

The authority also has announced that it will provide natural uranium fuel elements to match whatever volume of export business British industry may achieve. With this encouragement, some United Kingdom firms are quoting prices of about $56,000 per metric ton for natural uranium fuel fabricated.

LOOKING ABROAD

Differing with British industry, the Government does not anticipate any large export of nuclear reactors in the next few years. Its attitude is summed up in the statement: "It is reasonable to expect that orders from overseas will follow, rather than precede, the achievement of nuclear power on a competitive basis in this country."

And Plowden adds: "We believe it will be at least 10 years before competitive nuclear power stations of (30 Mw) size have been fully developed and tested and are available for large-scale use. There are, however, some countries, such as India, Turkey, and Egypt, where a few large thermal power station of about 100 Mw are planned."

The Government feels it can best serve the export interests of industry by laying down a sound domestic program. The interest of foreign observers at the Calder Hall symposium indicates this attitude is paying off.

Any expansion of Britain's nuclear program—and the Calder Hall symposium left little doubt of the enthusiasm that has been generated—inevitably will require some additional thought about the nation's international relationships in the nuclear field, particularly with the rest of Western Europe.

EURATOM VERSUS OEEC

Britain has not yet decided whether to go into the close-knit Euratom proposal or to adhere to the looser OEEC organization. Neither plan, of course, is in its final form, but the United Kingdom has shown a reluctance toward the Euratom project, particularly in regard to its proposed control of raw materials.

"It really would be asking too much to expect us to give up our own supply contracts with countries like the Belgian Congo and Canada and to hand them over to other countries which have not such a supply system," says one politician.

OEEC, which would permit nations to come into the organization to the extent that they wish without such binding agreements as those of Euratom, offers more appeal to the British at the moment. What effect an expanded atomic program will have on this thinking is uncertain, but it should swing Britain even more to OEEC.

How swiftly recent events have changed attitudes toward the nuclear power program can be seen in the following statement made in the House of Commons

on November 12: "It is only when coal, plus atomic energy, has been able to supplant oil that we shall be able to get out of the unhappy and dangerous position of being blackmailed by the oil-producing countries."

It was only a few short weeks ago that oil plus atomic energy was seen as an escape from a sorry coal situation. The one constant has been nuclear power. In that fact lies Britain's hope.

British Industry's Goal: A Better Calder for the World Market

As in the United States, the British nuclear power industry began as a Government monopoly—a complete monopoly on basic knowledge, design, construction, technical know-how. But unlike the Americans, when the British decided the time had come for industry to participate as an equal partner they proceeded in a much more paternalistic manner. The British Government, late in 1954, set about the organization of four consortiums or syndicates of large industrial concerns. It invited the four leading electrical equipment firms in Britain to study the Calder Hall type of reactor, to take into partnership a leading boilermaker and a civil engineering contractor, and to send teams to study at Harwell.

The four groups thus formed are: Nuclear Power Plant Co.; General Electric Co.-Simon Carves; English Electric Co.-Babcock & Wilcox Ltd.-Taylor Woodrow; Associated Electrical Industries-John Thompson.

As their first task, they were asked to bid, in competition, on the first two power stations for the Central Electricity Authority's 10-year white paper program, and for a station for the South of Scotland Electricity Board. All are to be improved Calder-type plants. The bids have been submitted, and awards are to be made in January.

A ROUNDUP

Four points emerge from a survey of the activities of the four consortiums.

1. The development effort has been 90-95 percent solidly behind graphite-moderated CO_2-cooled systems.

2. Groups are offering fixed-price bids for complete nuclear power stations, comparable operating costs per unit generated with the best thermal stations, and guaranteed performance and construction time.

3. Development potential revealed during the last 2 years by the consortiums greatly exceeds expectations and makes a major development switch from gas-cooled reactors unlikely in the next 10 years.

4. The fact that the gas-cooled plant gets by on natural uranium is proving a very valuable selling point in the export field.

Interest in all other systems does not absorb more than 10 percent—if that much—of the development and research capacity of any one of the groups; and it is slanted to the accumulation of corrosion and heat-transfer characteristics with liquid-metal coolants, rather than to specific system development. According to the group leaders, supremacy of graphite-moderated gas-cooled systems using CO_2 is assured in the power-generation field for at least the next 10 years; its usefulness is assured for the next 25. There is naturally a realization that systems using enriched fuels are inevitable, especially in the 30 to 50 Mw power bracket, but work will proceed upon them only as long-term policy. It appears that no group can hope to match Harwell's metallurgical research and irradiation facilities, and consequently any switch to alternative systems will need to depend on Harwell's guidance. Whether Harwell should exploit this situation financially is now being reviewed.

In achieving major advances in the Calder design, emphasis was placed by the industrial groups on the fact that no major design changes had been or were likely to be involved—perhaps only one group departed from the basic concept of a right cylinder for the reactor vessel. But gas pressures probably twice those at Calder have been used: this because better low-carbon steel alloys have been evolved and because advanced welding techniques have become available, permitting onsite welding of 3-inch plate. These factors alone were sufficient to make the most significant contribution to the increased specific ratings of the first bids.

The basic unit reactor size in all the first CEA proposals is several times greater than Calder Hall and appears to lie between 100 and 150 Mw. No serious development effort is apparent on units much below 100 Mw but at least one group is developing upward to 200 Mw units.

It is clear that considerable capital cost reductions on Calder Hall have been achieved, with at least one group quoting a figure as low as $280/kw installed

capacity. TheAEI-John Thompson group has even set its target for the next round of CEA bids at $250/kw installed. This figure nearly matches the price of $210 quoted to CEA by a new industry grouping, AMF-Mitchell Engineering, for a pressurized water reactor.

Construction times for, say, a 300-Mw station seem to be rated at about 4 years. Some groups speak of working up to one 300 Mw unit a year, with 3 to 4 in hand at any one time.

Graphite could be an immediate bottleneck, with 3-inch thick rolled plate running close second, but provision is being made to boost production capacity of both commodities.

WORKLOAD DISTRIBUTION

Each of the four main groups has now spent $1.5 to 2 million in establishing research and development facilities and preparing its first bids.

Distribution of the research and development load is different within each group. This is reflected in the design teams recruited—these range from 150 to 250 personnel—an in the varying extents to which member companies have assigned workers to the nuclear program. Research teams include pure and applied mathematicians, physicists and chemists, but are most heavily loaded with metallurgists and mechanical engineers. About half the teams are professional.

In two cases—the G. E. C.-Simon Carves and the English Electric-B. & W.-Taylor Woodrow groups—new project and design research laboratories were established alongside the mechanical engineering plants of the electrical company concerned. The two other major groups—Nuclear Power Plant Co. and AEI-John Thompson—have established independent project design offices, and research and development work is undertaken on plants of the electrical and steam firms in the groups.

RESEARCH PROGRAMS

The research programs of each group are basically similar. But the nature of the crash research program in each case has led to a number of highly ingenious, improvized metallurgical and heat transfer rates being evolved.

Much of the improved performance obtained by the groups with the gas-cooled graphite-moderated reactor arises from the use of higher gas temperatures and pressures, development of improved canning materials, and improved and stronger finning on fuel cans to withstand the very high heat and pressure loading involved. Major problems involve corrosion and oxidation of the can (believed in most cases to be magnox alloy—a magnesium-beryllium alloy), and of the steel shell in a wet CO_2 atmosphere; and the creep and fatigue properties of the fins. An increasing percentage of the metallurgical effort is now going into other canning materials such as zirconium and beryllium alloys.

All groups have examined many orientations of the fin to the gas flow, particularly transverse as used in Calder Hall. But in the final analysis, fabrication economics plays a big part. Different can-fabrication techniques have been investigated throughout the industrial groups, including that of impact extrusion of the can together with longitudinal fins, the helix being obtained by twisting. Among the novel equipment evolved is: thermo-balancing apparatus that gives a continuous weight reading while oxidation tests proceed; batteries of heat treatment furnaces using heated and pressurized CO_2 atmospheres; batteries of rigs on which the all-important stress/corrosion tests can be conducted simultaneously; apparatus for examining radiographically the "ratcheting" effect of the fuel rod in the can under thermal cyclic loading.

Heat transfer rigs show the most ingenuity throughout the groups. These operate with CO_2 under controlled conditions of pressure and temperature with provision for measuring gas temperatures, pressures, flow rates, and can temperatures to give a heat balance. A feature of group facilities in this department are the quick sampling rigs that operate with atmospheric air and make it possible to eliminate at an early point unsuitable finning arrangements. More importance has come to be attached to oxides and to surface roughness along the heat transfer interfaces.

No less importance attaches to the design and welding of aerodynamic fins needed to extend the heat transfer surfaces on the water side for the least pressure drop. One rig, passes dry superheated steam through the tube which is externally air cooled. The amount of steam condensed is then used to relate the effectiveness of different finning arrangements in the shortest possible time.

All groups have developed charge and discharge fuel loading equipment that can operate under system gas at pressure. It was a requirement that fuel elements be changed without shutting the reactor down. Other mechanical design developments by various groups include novel gas seals and gas bearings that are preferred to molybdenum disulphide solid lubricants by at least one group where normal lubricants are not permissible.

Little work has been done on either helium or hydrogen coolants, which offer both nuclear and thermodynamic advantages. Groups have been frightened away from hydrogen because of its ability to diffuse through the cans into the uranium with which it has a dangerous affinity, from helium because it is not domestically available.

MARKETING

All groups report firm inquiries from Germany, Italy, Japan, South America, and Commonwealth countries, but in general no company has yet applied positive sales pressure, deeming it premature until the CEA stations are underway.

One thing has become quite definite: most European countries are favorably disposed to the gas-cooled graphite-moderated station because it requires only natural uranium which is plentiful and absolves them from complete dependence on a particular country for the supply of enriched fuels.

It is also clear that if nuclear stations are to break into the field dominated by fossil fuel use, stations will have to be something less than 30 Mw. This means enriched fuel would be required, and investigations of the high temperature gas-cooled reactor using enriched fuel are becoming high-priority matters in the industrial research program.

THE FOUR INDUSTRIAL GROUPS

The Nuclear Power Plant Co. embraces eight member firms, each contributing to the cost of a central project design office in Knutsford, Cheshire. It is now staffed by 200 technologists, about half of them professional. Each member company has diverted further teams of up to 60 men on its own premises to take the nuclear research and development load in its own field.

One of the group's principal beliefs is that improved mechanical and control details of the Calder Hall type of reactor could lead to big capital savings. In particular the company intends to develop unit reactors both larger (200 Mw) and smaller (100 Mw) than Calder Hall, the latter probably being the most important in the export field.

Only a smal precentage of the professional personnel has so far been investigating other reactor systems, then mostly the basic heat transfer and corrosion problems associated with liquid coolants. At this stage the group had not exercised any pressure on the selling side but is prepared to develop firm inquiries.

Member companies of this group have made large contributions to Calder Hall and Chapel Cross. C. A. Parsons & Co., Ltd., who supplied the turbo-generator and gas circulating blowers for Calder A, will handle this equipment, ductwork and associated instrumentation for the group. Parsons is the largest turbo-generator concern in Europe and pioneers of the steam turbine.

Whessoe, Ltd., with a history dating back to 1790, were assigned the Calder Hall reactor vessel and will be responsible for this item. Whessoe is considered to have unsurpassed experience in site-welding of heavy plant construction. It has tackled most of the large supersonic pressurized wind tunnels in Britain, pioneered the construction of high pressure gas-holders and catcrackers there. It has already tooled up for batch production of eight Calder Hall type reactor vessels.

Sir Robert McAlpine & Co., the building and civil engineers to the group, were among the first advocates of reinforced concrete in Britain and claim to be the most mechanized British company in this field. Contracts have included 20 large thermal stations, oil refineries and steel works. Alex Findley & Co., Ltd., will supply structural steel and general fabrication.

Reactor equipment and heat exchangers will be supplied by Head, Wrightson & Co., Ltd., another leading British company about to celebrate its centenary. The firm makes complete process plants in the coal, gold, iron and steel, oil and chemical industries and has specialized in heat exchange equipment. It has seven subsidiaries in Britain, including iron and steel foundries, forges and fabrication shops. It produces a range of alloy steels and has extensive metallurgical research facilities. At present, Head, Wrightson has the most experience with heavy water research reactors in Britain.

The group have secured Strachan & Henshaw, Ltd., to supply the fuel handling equipment. This company has had extensive mechanical handling contracts for the U. K. AEA, including the fuel handling equipment for Calder Hall and Chapel Cross.

A. Reyrolle & Co., Ltd., switchgear and control gear makers to the group, has also been a large supplier to the Harwell, Windscale, Springfields, and Capenhurst establishments of AEA, and made the switchgear at Calder Hall and Chapel Cross. The company claims to be the largest maker specializing in switchgear equipment in the world. Reyrolle recently opened a new plant to fabricate and machine reactor graphite.

Completing this group is Clarke Thompson & Co., Ltd., who will supply steam raising, crane and lifting gear.

To coordinate the work of the eight member companies, the firm engaged the Parolle Electrical Plant Co., Ltd., jointly owned by Parsons and Reyrolle. This company has had a design team based at Harwell or Risley since 1947.

English Electric-B. & W.-Taylor Woodrow group has located its nuclear project design division at the Whetstone works of the English Electric Co., where much of the engineering and metallurgical development of the group is centralized. It includes about 100 professional people in a staff of 250.

The group pools much experience gained by its member companies at Calder Hall and Chapel Cross. Taylor Woodrow, Ltd., brought in to carry out the crash building and civil engineering program at Calder Hall, is one of Britain's largest civil engineering firms.

The English Electric Co., as one of Britain's main electrical contractors, will provide the turbo-generating and associated electrical equipment and all the instrumentation.

The pressure vessel and heat exchangers will be supplied by Babcock & Wilcox, Ltd., foremost steam generating plant engineers in Britain and supplier of the Calder Hall heat exchanger plant.

Plans of the Babcock & Wilcox organization are the most ambitious of any single company in the four consortiums. Though intending to remain in the group to work on Calder Hall type reactors, its ultimate goal is the design and fabrication of complete nuclear power stations. These will include pressurized water reactors, probably with fossil fuel superheating. This, the company contends, is a natural development for a company making boilers and steam plants. It plans eventually to reach steam conditions of 900° F. and 250 psi with gas-cooled reactors, using sintered beryllium-uranium fuel elements.

The company's production lines already wear a nuclear look. An impressive line has been established for the production of the Calder Hall A and B and Chapel Cross heat exchangers. A new tube and manifold plant costing $2.6 million enables mass production techniques to be applied in the fabrication and assembly of the heat exchanger, shell and tubing. Equipment includes batteries of automatic welding plant for studding the aerofoil fins onto the tubes. (Some 340 million are used on the 32 towers for Calder and Chapel Cross.) Other new plant includes large stress relieving ovens; new presses, one of 2,000 tons for dishing plate up to 8 inches thick; increased facilities for acoustic and radiographic testing. The machine shop has also been reorganized and equipped to match the flow lines established for welding and fabricating reactor assemblies.

At the company's Renfrew, Scotland, research establishment, there are 270 technicians—well over half of them professional. Special metallurgical equipment recently installed includes latest types of spectographic apparatus for the all-important measurement of trace elements; simulated scaling apparatus on which scaling losses can be predicted during 100,000 hours; 84 new hot-stress rupture machines; rigs on which ratcheting of fuel in the can under thermal cycling loads can be radiographed.

G. E. C.-Simon Carves has established its nuclear department at Fraser & Charmers engineering works, Erith, where most of the heavy mechanical plant for the General Electric Co. is made. Strength is up to 250 technologists—100 professional, of whom 75 percent are G. E. C., 25 percent from the Simon-Carves group of companies.

As its pressure vessel fabricators, this group has taken in the Motherwell Bridge & Engineering Co., which is building the sphere for the Dounreay reactor. None of the member companies was associated with the Calder or Chapel Cross stations. John Mowlem & Co. will handle the building and civil engineering program.

G. E. C. is the second largest electrical manufacturing group in Britain, has a capital of $180 million and a total payroll of 71,000.

Again, effort is largely channelled to gas-cooled graphite-moderated reactors; about 10 percent of professional staff is working on general problems of corrosion with liquid metal coolants, principally Na, NaK, and some undisclosed slurries. Homogeneous reactors form no part of the planning; the group has no interest in water reactors because of "bad steam conditions."

Research equipment includes several ingenious rigs, and the company was the first to install an analog computer for analysing transient reactor operating characteristics.

Unit size of the company's reactor is 150 Mw, and it has already submitted a bid of this size, based on the CEA proposal, to a Continental and a Commonwealth country.

AEI-John Thompson Nuclear Energy Co., Ltd., is one of the groups making a big bid for leadership among the consortiums. Associated Electrical Industries, Ltd., which includes Metropolitan-Vickers, Ltd., and the British Thompson-Houston Co., is the largest electrical group in Britain; John Thompson group of companies includes several large chemical and steam plant subsidiaries and a contributor to the Dounreay reactor.

The nuclear division is located at Knutsford, Cheshire, and presently employs 100 technicians, plans to have 300 by mid-1957. The group is now building up facilities to investigate several reactor systems but has so far worked exclusively on Calder-type reactors. One of its activities has been the development of electromagnetic liquid metal pumps; it also offers a research reactor commercially.

OTHER FIRMS

In addition, Mitchell Engineering, Ltd., and AMF Atomics of New York have decided to collaborate—the only such case of Anglo-American partnership. Mitchell designs, erects, and installs complete power stations and claims to be the largest private company in the world. Annual turnover reaches $140 million. All the nuclear aspects of the group are handled by AMF Atomics of New York. The reactor it will offer is a closed-cycle boiling-water unit operating at 900 psi and 900° F. Installed cost is $210/kw. Power stations will be compounded from 20 Mw or 30 Mw units.

Another newcomer to the industrial nuclear power field is the Hawker Siddeley Nuclear Power Co. This group now has a laboratory-equipped team of 60 people working on small homogeneous reactors of 3 Mw and up. Both steam and gas turbine prime movers are envisaged, depending on the availability of water. The company has substantial Government backing. At the moment, its effort is concentrated mainly on the corrosion problems of the system using standard equipment and techniques. Applications include marine propulsion, but it is generally intended for industrial power generation. The company is aiming at replacing the diesel engine with its dependence on oil.

Rolls Royce, Ltd., also has its finger in the nuclear power field with at least one marine application and an interest in nuclear propulsion for aircraft, but the whole of the company's program is heavily shrouded in secrecy.

A Power-Hungary World

London on November 22 and 23 was a "little Geneva." As in 1955 at the Geneva atomic energy conference, representatives of a number of countries were "shopping." This time, however, there was only one vendor—the United Kingdom—and only one reactor type on view—Calder Hall.

At least 13 nations other than England sent men to the meeting: France, Sweden, Italy, Netherlands, Belgium, Norway, Spain, Denmark, Switzerland, Japan, West Germany, Czechoslovakia, and the United States. Some were very strong prospects for Calder-type plants. Others were very much on the fence. And still others were merely seeking information.

Many of the countries represented had already been approached both by the Atomic Energy Authority and by the industrial groups. In fact, various British companies have submitted bids on large Calder-type plants to countries such as Japan, West Germany, Italy, and Australia. There are two main appeals that Calder has for many of these countries: it's an operating reactor, and it uses natural uranium. The latter probably carries the greater weight because, even though the United States is making enriched uranium available at low prices, many nations don't want to tie themselves to any one country for fuel supplies.

A big disadvantage of Calder is that, at the moment, it is quite uneconomic in small sizes. And it is the smaller size plant—20–30 Mw—that is in demand in the countries seeking power reactors right now.

Here is why some nations sent representatives to the symposium, and what their interest in Calder Hall is:

JAPAN

One of the principal targets of British—and United States—sales efforts, Japan had only a few people at the meeting. However, one of several study teams that has been traveling abroad looking into various nuclear power schemes had just left the country after having been wined and dined by prospective vendors much as in the United States several weeks earlier. Although there has not yet been any announcement from the United Kingdom or Japan, there is now strong indication that the Japanese are favorably inclined toward a Calder-type unit. While in the United States, the Japanese said they had received an offer from the United Kingdom of a 100-Mw plant for $38 million.

SPAIN

This country has already bought two small research reactors and now expects to buy, by next spring, a small power reactor in the 20–30-Mw range. Thus Calder Hall is too big for them. They're actually looking quite seriously at United States pressurized and boiling water reactors. However they did send a team of technical people to the London symposium to size up Calder. Because there was no discussion at the meeting of current designs, they said they were not able to get the kind of picture they were looking for.

BELGIUM

The Belgians recently made a decision to work toward buliding a fast reactor. But prior to this, they want to build a large thermal-neutron plant, of the order of 100 Mw. And so they're quite interested in Calder Hall. The thought they expressed at the meeting was that they doubted they would buy a complete plant, but rather would depend mostly on the United Kingdom for information about Calder.

FRANCE

There were about 15 representatives of French industry and as many from the French atomic energy commission. Design of the French plant G–2 due to come into operation late next year is very similar to that of Calder Hall, and for that reason the French were extremely interested in the problems the British have encountered with their gas-cooled graphite-moderated unit. Although the French are working with somewhat higher pressures, they are aiming at a similar output. Two points on which the French design differs from the Calder Hall station; it uses horizontal instead of vertical channels, and it is designed to permit charging and discharging during operation. But to the French the main importance of the symposium was that it was on a design so similar to theirs.

SWEDEN

Sweden is interested in relatively small water-moderated and water-cooled plants for heating purposes. Therefore the Calder Hall design *in toto* was of no interest to them. However they were quite interested in questions relating to reactor safety and to the British approach to shielding. They hoped to find useful ideas in the British answers to these problems. According to Dr. Torsten Magnusson of the Swedish Delegation, within 20 years Sweden will have to develop a strong nuclear power program to meet the gap in its energy needs. The first Swedish reactor for heating, with an output of 100 Mw (heat), is planned for operation in 1960. By 1962 Sweden hopes to have in operation a dual-function reactor that will have an output of 14 Mw electrical and 75 Mw heat (see p. R10).

Another Swedish interest was expressed by P. H. Margen of the Swedish Atomic energy Co., who was looking for details on graphite manufacture and fabrication.

ITALY

A large delegation from both government and industry was present. It was on a shopping tour, for Italy anticipates a need for several large power reactors of the Calder-Hall type. One member of the delegation said the Italians were coming away from the symposium with the impression that the British type was much more suited to the needs of European countries, particularly owing to its

use of natural fuel, than anything the United States had to offer. He said the experience the British have gained in actually operating this type would also be invaluable to any country purchasing one. The Italians have bought a 5-Mw heavy-water research reactor from the United States which they hope to have operating in 1 year. They plan to buy their power reactors abroad as well. The Italians also were quite interested in the fact that the British had pushed this type of reactor while the United States has passed it up completely.

One Italian commented that Calder Hall itself is already an obsolete station and complained that the British companies were unable to give full information to them on the more advanced sets because details are being withheld until after the announcement of awards on the bids for the Central Electricity Authority stations.

NETHERLANDS

Representatives of the Dutch Government also mentioned that while they were able to talk with the AEA, they were not permitted to discuss the new designs with the companies. The Dutch definitely are in the market for a power station of about 125 Mw. They are considering two types: Calder and the PWR. They would prefer to stay with natural uranium.

SWITZERLAND

The Swiss sent Jacques Lalive Dépinay, representing Brown, Boveri & Co., one of a small group of foreign delegates, to visit Calder Hall after the symposium. He was greatly impressed by the similarity that fabrication of the Calder Hall type bears to conventional steam plants, but had formulated no preference as yet between graphite-moderated and pressurized water reactors.

DENMARK

Research Director P. C. Jacobsen, of the Danish Atomic Commission, though impressed by characteristics of graphite-moderated gas-cooled reactors, said no firm plans had been formulated. The commission has no design or manufacturing powers but will act in an advisory capacity to industry. But, he thought, because of the shortage of suitable coal in Denmark it was likely that a decision would eventually be made in favor of the Calder Hall type of around 100 Mw.

The Calder Hall economic data should not be used as a basis for a long-range evaluation of the gas-cooled type of reactor any more than the first Shippingport reactor cost data should be used as a long-range criterion for pressurized-water reactors. The Calder Hall plant is a sort of reactor experiment and was designed as a plutonium producer first and a power producer second.

Relative values of the operating cost of the Calder Hall reactor are of interest, however, because they can give some sort of a basis for our long-range expectations.

Table 1 shows the cost per kilowatt-hour of the Calder Hall plant operated at 80-percent load factor with fuel irradiated to 3,000 Mwd/ton and a fuel loading costing $56,000 (£20,000) per ton.

An accurate analysist of the Calder Hall type of reactor will be possible as soon as the contents of the four bids to the United Kingdom AEA are made public. However, it is possible to make certain calculations of fuel costs based on available information. With the prices of $56,000 per ton of natural uranium in the form of fuel elements and a resale value of $16,800 per ton after 3,000 Mwd/ton irradiation, the cost comes to:

Operating cost, 2.2 mills/kwh.

Inventory charge at 6 percent (4 percent plus holdup for cooling and shipping). Present heat rate, 1.5 mills/kwh. Double present heat rate, 0.75 mills/kwh.

Thus it appears that a total fuel cost of 3 mills/kwh will be achievable with Calder Hall reactors if, as is probable, doubling of the heat rate is possible.

The plant of the Calder Hall variety must of necessity be operated as a base-load plant since the installed cost and consequently the fixed charges will be high with a rather lower operating cost. The corollary is that minimum interruption for refueling is required, indicating that future Calder Hall designs should be capable of being refueled without disturbing system pressure.

The basis for the fixed charges in the Calder Hall reactor is very different from the basis used in the United States for either conventional or atomic power generation. In common United States practice, 14 percent for conventional

plant and 15 percent for atomic plant is used to cover debt service, amortization, and depreciation.

The charges used for the Calder Hall reactor are 4 percent for the interest and 20-year depreciation for an average total of 8.02 percent. Thus the already high capital charges of the Calder Hall reactor would be nearly doubled if the plant were to be built in the United States or in a country with an equivalent economic structure.

TABLE 1.—*Cost of Calder Hall electrical output*

	Mills per kilowatt-hour	Pence per kilowatt-hour	Percent
Capital charge	6.5	(0.56)	53
Fuel inventory charge	1.2	(.10)	9
Fuel consumption charge	4.1	(.35)	33
Operation and maintenance	.6	(.05)	5
Total	12.4	(1.06)	100

TABLE 2.—*No. of Pu atoms to replace 1 U^{235} atom without altering reactivity*

For pure Pu^{239} fuel	0.44
For 3,000 Mwd/ton Pu from natural-U reactor	.75
For equilibrium plutonium	2.38
For equilibrium plutonium without Pu^{242}	.99

TABLE 3.—*Increased efficiency with high temperature*

	Heat output	Electrical output	Fuel rating	Efficiency, electrical / heat
	Thousand watts	*Thousand watts*	*Thousand watts per ton*	*Percent*
Case A: larger Calder design	400	100	2.0	25
Case B: High-temperature reactor:				
Flattened neutron flux	1,400	433	5.8	31
Unflattened flux	1,100	340	4.5	31

PLUTONIUM PRODUCTION

The Calder Hall reactor will generate a substantial amount of plutonium. This plutonium will have, of course, a value when used in weapons but advanced planning based on plutonium recycling has been carried out.

The plutonium formed could be used directly in place of U^{235} in small enriched reactors in which the problems of fuel-element fabrication could be overcome, and it could be used also to provide additional reactivity in other plants.

In addition, the possibility of long-range multiple recycling of plutonium has been considered. However, this procedure has disadvantages because as plutonium burns, Pu^{240} and Pu^{242}, which are nonfissionable, are produced in large quantities. Their equilibrium concentration is dependent only upon their neutron capture rate. Their adverse effect is brought out clearly in table 2.

Fuel burnup

The importance of long reactor burnup is shown in figure 1. It appears that 2,000 to 3,000 Mwd/ton is essential and that there is relatively little interest in going beyond 4,000 to 5,000 Mwd/ton.

HIGHER-PRESSURE OPERATION

The performance of the Calder Hall type of reactor is limited by the maximum estimated pressure that can be accommodated as well as by the maximum estimated temperature. Since the core is extremely large (~30 feet) it becomes necessary to fabricate the reactor on the site.

The present Calder Hall reactor vessel is limited to 2-inch-thick steel plate. In the event that greater thicknesses of steel plate are available, the heat output

of a given reactor can be increased substantially for a given pumping power. Since the total capital cost of the plant will increase much more slowly than the reactor thermal power, the final cost per kilowatt would be expected to drop considerably from that of the present Calder Hall reactor.

Since operation at a higher pressure level would not in any way change the basic metallurgy and physics of the Calder Hall reactor, the possible change to higher plate thickness would only depend upon the ability of the constructor to fabricate pressure vessels of greater thickness.

Preliminary reports indicate that it is possible to fabricate spherical pressure vessels of acceptable size and 3-inch thickness. This should provide a substantial power increase.

HIGHER TEMPERATURES

As a long-range development the use of high-temperature gas-cooled reactors is currently being considered. These reactors would require a completely different basic technology from the Calder Hall type.

If high-temperature reactor operation were possible, e. g., with other fuel-cladding materials, a substantial increase in efficiency and decrease in capital cost would result. This increased efficiency is shown in table 3.

The case B reactor is designed for 1,100° F. (600° C.) operation, which was selected without reference to a particular material. This temperature shift would require complete reinvestigation of all the basic metallurical problems in the Calder Hall reactor. The reaction of CO_2 with every material in the reactor could be expected to be speeded up. It is unlikely that these improvements could be made in the near future.

Effect of fuel element design

Table 4 shows that it is not possible to raise the maximum temperature of aluminum- or magnesium-clad elements much above the present value of 400° C. because of their low melting points. Thus the magnesium technology has about reached its limit and to get substantially higher temperatures, other materials must be considered. However, the other metals listed have substantially worse thermal conductivity and, in two cases at least, have a relatively large neutron-capture cross section.

TABLE 4.—*Possible uranium cladding materials*

	Aluminum	Magnesium	Beryllium	Niobium	Zirconium	Stainless steel (18/8/1)
Neutron cross section (cm^{-1})	0.0118	0.0023	0.00011	0.061	0.0076	0.227
Melting point (°F.)	1,220	1,202	2,343	4,379	3,362	2,732
Thermal conductivity (C.H.U./hr/ft/°C.)[1]	130	90	70	36.4	14.4	9.2
Density at 68° F	2.7	1.74	1.85	8.57	6.5	7.9

[1] C.H.U. is centigrade heat unit.

TABLE 5.—*Possible uranium ceramics for fuel*

	U	UC	UO_2	UC_2
Melting point	2,070	1,082	4,532	4,100
Density	19	13.5	11	11.28
Thermal conductivity at 122° F. (C.H.U./hr/ft/°C.)	3.75	4.6	.29	.47

The low thermal conductivity means that the fin efficiency of extended surfaces would become so small that fins would not be effective. The high netron cross section means that a departure from the basic concept of natural uranium fuel would be necessary.

Ceramic fuel elements

The possibility of ceramic fuel has been considered. Table 5 gives the properties of some of the common ceramics.

The use of ceramic elements at gas-outlet temperatures of around 1,500° F. (800° C.) presents a brand new materials problem. The thermal and irradiation

stability of the graphite and the ceramic presents a larger research problem. It would be highly desirable to prevent the spread of fission products into the primary coolant loop. The overall efficiency of such plants could, however, be comparable to the highest steam plant efficiency obtained today.

Gases other than CO_2

Other gases have been considered as an alternative to CO_2. Helium of course is preferable on chemical and high-pressure grounds, but would not be available in the quantities necessary. Hydrogen has excellent heat-transfer properties but essentially unknown chemical properties, and, of course, in the event of hydrogen leakage, a serious explosion hazard would exist.

If a gas with better heat-transfer properties is used, however, the value of the fins will be seriously reduced and then a basic change in fuel-element design would be indicated. The only way to satisfactorily compare the performance of different gases is to prepare a detailed design.

Steam cycles

It was pointed out by W. R. Wooton of Babcock & Wilcox, Ltd., that the application of supercritical steam cycles to the gas-cooled reactor might give extremely high thermal efficiency at temperatures lower than those required for reasonable gas-turbine operation. Figure 2 compares closed steam and helium cycles [1] with a supercritical steam cycle and a somewhat more efficient gas-turbine cycle. The steam-cycle data is perhaps a little optimistic and the gas-turbine cycle a little pessimistic, but it is clear that a supercritical water cycle may offer an extremely efficient means of generating power from intermediate-temperature reactors. This temperature range might be 900–1,100° F.

Gas-turbine cycles

Operation at very high temperatures naturally leads to consideration of gas-turbine cycles. The cycle of the Escher-Wyss type has been considered by Stenning and Howieson, of Chalk River. The schematic diagram of the cycle is shown in Fig. 3. Both CO_2 and helium were considered and a maximum gas pressure of 300 psi and a maximum gas temperature of 1,000° F. (538° C.). These are probably the most unfavorable conditions that could be selected for a cycle that could be expected to work.

The machinery required would be large and costly. Even at 1,000° F., however, the calculated efficiency is 29 percent and if the temperature were raised to 1,250° F. (677° C.), the efficiency would be 38 percent. To achieve competitive capital cost with steam, the pressure would have to be considerably higher than 300 psi. However, it seems likely that pressures up to 1,000 psi could be feasible with this sort of system and the rotating machinery could be made quite small and compact.

SUMMARY

The Calder Hall reactor with its solid-rod fuel element clad in magnesium or aluminum is probably near the end of its ultimate development so far as temperature is concerned. Increases in system pressure will of course result in increases and improvements in plant economics. A new technology of materials would be required for the next step of large increase in temperature, along with the application of closed-cycle gas turbines as an alternative to steam.

ADDRESS BY REAR ADMIRAL H. G. RICKOVER, USN, CHIEF, NAVAL REACTORS BRANCH, DIVISION OF REACTOR DEVELOPMENT, UNITED STATES ATOMIC ENERGY COMMISSION AND ASSISTANT CHIEF OF THE BUREAU OF SHIPS FOR NUCLEAR PROPULSION, BEFORE THE NAVY GUIDED MISSILE PREVIEW LUNCHEON, SHERATON-PARK HOTEL, WASHINGTON, D. C., FRIDAY, MARCH 1, 1957

THE CHALLENGE OF NUCLEAR POWER

Many factors have been suggested as the major source of difficulty in achieving nuclear power. Secrecy, the novel scientific concepts involved, legal and governmental restrictions—each of these has been cited as the major stumbling block.

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[1] Reactor Handbook: Engineering, p. 377 (U. S. Atomic Energy Commission and McGraw-Hill Publishing Co., Inc., New York, 1955).

But the one factor which today most severely limits our exploitation of nuclear power is neither legal nor governmental. It is not a lack of new ideas, nor even a lack of understanding of recently developed ones. These do have some effect. The main problem is with materials and equipment generally considered as conventional, but which must conform to the exacting standards required of all components of a nuclear powerplant.

Just as the strength of a chain is no greater than that of its weakest link, so does the successful operation of a nuclear powerplant depend on the reliability of all its parts—not alone the nuclear reactor, but also the heat exchangers, pumps, valves, etc. In fact, our experience with the four operating plants of the naval reactors program has shown that it is these components which have proved less reliable than the nuclear reactor itself. Also, the cost of these components has been high and their delivery time poor. They have thus been the cause of much of the high cost and long completion time of today's nuclear powerplants. Here, I believe, is an aspect of nuclear power whose importance is little understood, and which presents a challenge to industry.

It is commonly believed that nuclear power development is primarily the province of the nuclear physicist. Nothing could be further from the truth. What actually faces us is the need to determine by calculation and by experiment how best to remove heat from a reactor, and then to design and build all of the components that make up the reactor system in such a way that they will operate efficiently and reliably under the rigorous conditions inherent in nuclear power generation.

It has not been difficult to focus the necessary attention on the novel features of nuclear power, such as the nuclear reactor itself. Here new problems were expected; they were easily recognized, and are being reasonably well solved. But it has been very difficult to get sufficient effort directed toward the more conventional aspects of nuclear plants—the heat exchangers, the pumps, the valves, the instrumentation. Here normal engineering and manufacturing techniques have proved to be inadequate when applied to nuclear plants. To manufacture satisfactory nuclear plants requires that the whole plateau of engineering design, materials, inspection, and training be raised significantly above present levels. This is so because a failure which would be trivial in a nonnuclear application could have serious consequences where radioactivity is involved. It is also more difficult to maintain and repair equipment which is radioactive and welded hermetically tight.

Since the nuclear reactor is the most challenging and noval of the components that make up a nuclear power system, it attracts most of the technical attention. So it is not surprising to find that when industry speaks of getting into the nuclear power field, it almost invariably refers to the design and development of reactors alone. Today many companies interested in nuclear power dissipate the efforts of their technical manpower on academic reactor feasibility studies, but give little, if any, consideration to the overall reliability of the plant. The necessity for improving design and performance of the conventional-type equipment, which transforms the heat generated by the nuclear reactor into useful power, is apparently either not understood or is disregarded. As a result not enough effort is being expended to improve this equipment so that it can meet the exacting demands of nuclear power applications. The extent of this neglect cannot be measured in time and dollars alone; it must also be measured in terms of what is today one of our scarcest and most priceless assets—trained technical manpower.

Let me give you some examples to demonstrate how today's normal engineering methods and manufacturing controls have proved inadequate for nuclear application, and the steps which are being taken to remedy the situation. You will see from these examples that the development of naval nuclear propulsion is not a normal development which will follow inevitably from today's engineering and organzational facilities. On the contrary, it requires special effort both in engineering and in management.

Three main factors are responsible for most of our difficulties in applying conventional-type components to nuclear powerplants. They are:

First, the need for shorter manufacturing time than is customary in conventional powerplants. Second, the use of materials in shapes and under conditions different from those with which industry has had experience. Third, the need for more rigorous criteria to evaluate the adequacy of materials and equipment.

Let me amplify these points: First of all, there are good reasons for requiring shorter manufacturing times. The development of a nuclear reactor is a technically difficult and time-consuming undertaking. If the United States is to

capitalize on any technological lead we may have in this field, our nuclear powerplants must be built in a short time. For this reason our practice is to order the conventional-type equipment for nuclear plants as soon as a preliminary design of the nuclear reactor has been firmed up. But our invariable experience has been that industry cannot deliver this equipment as quickly as it is needed; and this prevents us from fully exploiting our technological advantages. This is a sobering fact, especially since the welfare of our country in the future may well depend on the rapidity and the effectiveness with which we are able to exploit new concepts.

Second, nuclear powerplants today require components which have different shapes and which are capable of operating under different conditions than those with which industry has had experience. We had expected that industry's technological know-how was sufficient to take care of these modest departures from conventional practice. We found this not to be so; in fact, we found that industry frequently has inadequate understanding of the fundamentals involved in straightforward applications. For this reason many of the problems that have arisen in our program have had to be solved by empirical means. We have been forced to try many approaches, hoping that one would work. We cannot try all possibilities, and we cannot afford to continue trying several possibilities.

We must first understand why something will work or will not work. Until the fundamental processes involved are understood, additional large-scale use of technical manpower and money will be required to solve each new, even slightly different, problem as it arises.

The empirical methods we are using are rapidly becoming unsuitable for solving these problems. This empirical approach is enormously wasteful of money and trained technical manpower; it also results in unexpected and unexplainable flaws and failures. These continue to plague us, and cause considerable delay.

Finally, the necessity for use of more rigorous inspection criteria arises from the emphasis we necessarily place on reliability. Failure of a component in a nuclear powerplant has far greater significance to plant safety and operation than a similar failure in a conventional plant. The reason, as I have mentioned, is the radioactivity hazard, and the resultant difficulty of access for manitenance and repair. While this can be minimized by proper choice of reactor coolants, serious problems nevertheless remain, which have not been sufficiently appreciated by many who are working on reactor plant desing and manufacture.

Thus, it is clear that conventional-type components when used in nuclear powerplants must meet far more exacting standards, and must demand a higher order of engineering than similar components used in normal industrial applications. This is a challenge to industry which is not yet thoroughly understood or accepted.

To illustrate the problems which arise from these special requirements of nuclear powerplants, I will give you a few examples. Thèy can be grouped as follows:

First, lack of fundamental understanding even of common materials and of their fabrication.

Second, lack of management attention to the work, both from an organizational and from a detailed technical standpoint.

1. Lack of fundamental understanding.

(*a*) Our present knowledge of stainless steel is far from satisfactory. We have had to devote excessive attention to its fabrication and weldability to assure that the end product will be satisfactory. This is a field where fundamental knowledge leading to more effective methods and techniques is urgently needed.

(*b*) Many of our steam generators use stainless-steel tubes. Despite every design and operation precaution taken by us, we have experienced leaks in some of our steam generators. One corrective measure is to stress relieve the stainless-steel tubing to minimize erosion. The manufactures of this equipment have had years of experience in fabricating tubes. Yet, when they were confronted with the requirement to stress relieve stainless-steel tubes, without resultant surface contamination or distortion, they needed no less than 5 months to develop their processes. These 5 months were not anticipated by us and caused a corresponding delay in the completion of the steam generators for one of our newer ships. But even after this delay of 5 months and the expenditure of close to a million dollars, we still do not have a good understanding of this technical problem. Here, as in many other cases, we had to spend considerable time and money on a brute-force approach, because

there was no hope of obtaining an understanding of the fundamentals involved in a reasonable length of time.

(*c*) Obtaining sound carbon-steel forgings and castings has continuously plagued us and is a major problem. Experiences with defective forgings and castings have forced us to order twice as many as are actually needed in order to insure a sufficient number of satisfactory ones. For example, one of our contractors needed about 50 large forgings. Yet no less than 100 had to be made in order to supply these 50; the other 50 were so poor they had to be scrapped. I estimate that during the next 5 years the naval reactors program alone will require about 600 large forgings. If the present rejection rate continues, an additional 600 forgings will have to be made and scrapped, at a waste of millions of dollars.

(*d*) The same is true of large stainless-steel castings. Many of these have had gross defects. We have had to become reconciled to the fact that here again extra units must be made to be certain of obtaining a sufficient number of good ones. We still have not learned why these difficulties arise and how sound parts can be assured. I estimate that 2,750 castings weighing about 7,500,000 pounds will be required during the next 5 years in the naval program. If the present rejection rate continues, about 4,100 castings will have to be made in order to meet this requirement. The cost of the additional castings which will have to be scrapped is estimated as several million dollars.

These rejection rates for forgings and castings certainly do not speak well for our fundamental understanding of materials and their fabrication.

2. My second point, the need for an entirely new quality level of management to insure a satisfactory product is even more important, but more difficult to illustrate in a brief talk.

We have found that before a company can produce heat exchangers, valves, pumps, instruments, or other components suitable for a nuclear powerplant, a complete revision of its normal organizational procedures is necessary. A full-time project manager responsible directly to top management must be placed in charge of the nuclear products. He must establish new levels of engineering and scientific competence. This generally requires that personnel be given special education and training—academic evening courses at nearby schools or universities, and practical courses at the plant itself. Management will have to pay more attention to the training of personnel in administrative methods and in purchasing and expediting.

New tools and procedures for inspection must be developed and put into use. Facilities for testing raw materials and the final product must be designed and installed. Often these are very expensive.

In short, an entirely new level of technical and administrative competence must be built up for even the so-called conventional-type equipment.

For example, in one experimental program 9 small industrial-type pumps were ordered, 1 at a time, over a period of a year by our laboratories. These were a standard commercial product, ordered from several companies, out of their catalogs of stocked items. They were to be used for laboratory tests of a completely nonnuclear nature. Yet, each of the nine pumps had some serious defect upon delivery; poor castings which allowed gross leakage, misalinement which prevented operation, incorrect material used. Such defects can easily be corrected in most applications; they are only a nuisance. In a nuclear powerplant, however, where radio activity is involved, such defects are intolerable.

Contrast this situation with the performance of the special canned-rotor pumps we had to develop for nuclear application. These developmental pumps, welded into place, require no lubrication and have run for years without inspection. They have received no attention and show no signs for needing any. Three industrial concerns have now been trained to make these pumps. Because of their reliability they are now also finding use in nonnuclear applications.

The difficulties I have discussed represent a very small number of those we have so far encountered; as our program expands the number of problems increases. They are but an indication of the difficulties with so-called conventional-type equipment which must be faced and solved before a nuclear-power industry can become a reality.

Two lessons stand out from what I have said:

First: To much dependence is currently being placed on routine design and production methods. Practical nuclear power cannot be achieved by routine

methods. The performance and safety standards of nuclear plants pose problems which require technology far in advance of that now being used. We have found from numerous and repeated experiences that the only way these problems can be solved is by special and persistent attention by management. One or more individuals, competent in technology as well as in administration, must be appointed on a full-time basis in each organization to follow the nuclear work and to report directly to management. Otherwise, management will not really know the status of these development items and will not be able to make certain that satisfactory results will be achieved on time.

Second: Companies should determine where their background and talent can best meet the needs of nuclear power. For most companies this is not in the design of the reactor itself; rather it lies in the development or perfection of reliable, higher performance materials and components. Right now nuclear power requires that practically everything be designed by scientific methods.

Today there exists both a great opportunity and a great challenge in the nuclear-power field. Those who realize that a major function of management is to plan for the future, and who are willing to undertake difficult work, including achievement of better understanding of fundamentals, will be the ones who remain in this field and benefit from it because they will be solving tomorrow's problems today.

If this challenge is accepted and successfully met, the entire level of technology, management and productive skill in the United States will be raised. This is of vital interest to our country if we are to maintain the technological supremacy which is fundamental to our survival.

The CHAIRMAN. The committee is adjourned until Tuesday at 10 o'clock.

(Thereupon, at 3:45 p. m., Thursday, February 28, 1957, the Joint Committee recessed, to reconvene at 10 a. m., Tuesday, March 5, 1957.)

DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY

TUESDAY, MARCH 5, 1957

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The committee met at 10 a. m., pursuant to recess, in room 445, Old House Office Building, Hon. Carl T. Durham (chairman of the Joint Committee) presiding.

Present: Representatives Durham (chairman of the committee), Holifield, Price, Dempsey, Cole, Van Zandt, Patterson, Jenkins, and Senators Pastore and Gore.

Also present: James T. Ramey, executive director, George E. Brown, Jr., David R. Toll, professional members of the staff, and George Norris, Jr., committee counsel.

The CHAIRMAN. The committee will come to order.

This is a continuation of the hearings on section 202, which adjourned last Thursday.

This morning we will begin by the executive director asking General Fields and his staff a series of questions. These questions were communicated to the AEC last Friday.

I think most of these general subjects were covered throughout the hearing, but in order to have them in chronological order, I think it would be well to ask them of the General Manager.

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STATEMENTS OF K. E. FIELDS, GENERAL MANAGER, ATOMIC ENERGY COMMISSION; R. E. HOLLINGSWORTH, ASSISTANT GENERAL MANAGER FOR ADMINISTRATION; WILLIAM MITCHELL, GENERAL COUNSEL; E. J. BLOCH, DIRECTOR, DIVISION OF PRODUCTION; H. N. ESKILDSON, CHIEF OF ADMINISTRATION (ACTING) DIVISION OF PRODUCTION; W. KENNETH DAVIS, DIRECTOR, DIVISION OF REACTOR DEVELOPMENT; DR. C. L. DUNHAM, DIRECTOR, DIVISION OF BIOLOGY AND MEDICINE; CLARK VOGEL, ASSISTANT DIRECTOR, DIVISION OF INTERNATIONAL AFFAIRS; JESSE C. JOHNSON, DIRECTOR, DIVISION OF RAW MATERIALS; DR. T. H. JOHNSON, DIRECTOR OF DIVISION OF RESEARCH; C. L. MARSHALL, DIRECTOR, DIVISION OF CLASSIFICATION; D. F. MUSSER, DIRECTOR, DIVISION OF NUCLEAR MATERIALS MANAGEMENT; C. A. NELSON, DIRECTOR, DIVISION OF INSPECTION; H. L. PRICE, DIRECTOR, DIVISION OF CIVILIAN APPLICATION; MORSE SALISBURY, DIRECTOR, DIVISION OF INFORMATION SERVICES; OSCAR S. SMITH, DIRECTOR, DIVISION OF ORGANIZATION AND PERSONNEL; DON S. BURROWS, CONTROLLER, DIVISION OF FINANCE; A. TAMMARO, ASSISTANT GENERAL MANAGER FOR RESEARCH AND INDUSTRIAL DEVELOPMENT; BRYAN F. LAPLANTE, SPECIAL ASSISTANT TO THE GENERAL MANAGER; ALFRED HODGSON, DEPUTY DIRECTOR, DIVISION OF ORGANIZATION AND PERSONNEL; AND SHELBY THOMPSON, DIVISION OF INFORMATION SERVICES

Mr. FIELDS. Mr. Chairman, we have reviewed the questions that are attached to your letter. We haven't prepared a statement on the questions. We rather would have individual division directors responsible for the program concerned in turn answering the questions as we go through.

The CHAIRMAN. Mr. Ramey.

Mr. RAMEY. Following in order on these chapters that were submitted for the record, chapter II on isotopes, it is stated on page 14 that:

> The economic feasibility of private enterprise participation in radioisotopes production appears imminent.

Does the word "imminent" mean in the next year or two, or what is your general idea of the time schedule?

Mr. FIELDS. Mr. Chairman, I would like Mr. Price, who is the Director of Civilian Applications, to answer that question.

The CHAIRMAN. Mr. Price.

Mr. PRICE. Mr. Chairman, what we had in mind here would be, for example, the situation on cobalt 60. Specifically we do have in mind the period of the next couple of years.

The situation is that we are now producing about 300,000 curies a year of cobalt 60 for distribution to licensees for research and development purposes.

There is building up a demand for megacurie quantities for industrial use.

Looking at that demand as we see it developing, it is our view that a reactor to produce megacurie quantities would be economically feasible and could sell the material at a price that would make it attractive for the various industrial uses that we have had inquiries about.

There are companies interested in this. I certainly cannot say that we have any firm proposals by anybody to build such a reactor.

The CHAIRMAN. So the average layman can understand it in reading the record, can you convert curies into grams?

Mr. PRICE. As I understand, curies relate to specific activity. I could not convert it. I suspect somebody here could.

Mr. FIELDS. Could we supply that conversion for the record? It varies quite a bit with the material. You do have to be an expert in order to know the exact terms in grams.

(The information referred to follows:)

10,000 curies of Co–60 are equal to 10,000 grams of radium in terms of radioactivity.

Mr. RAMEY. What would be the approximate capital cost of a private reactor designed to produce radioisotopes? You have had some studies, have you not, like the one by the Stanford Research Institute and others?

Mr. PRICE. I do not know that we have any definitive figures. We have assumed the possibility of, say, a radioisotopes reactor with 20 megawatts of heat to produce at least 1 megacurie of cobalt 60 a year. That is roughly the size of the EBWR, and in round numbers, say, $5 million, more or less.

Mr. RAMEY. Would it be possible to have a kind of dual-purpose reactor that would produce radioisotopes and, say, process steam, or something used for some other purpose?

Mr. PRICE. That is right. There is some interest in the possibility of a reactor to produce radioisotopes and to sell the steam as a by-product.

Mr. RAMEY. Does that look like it has any economic possibility?

Mr. PRICE. I think it is our view, from our discussions with some of the companies that are looking into it, that this looks like a real possibility.

Mr. RAMEY. Mr. Chairman, Congressman Dempsey mentioned that he would like to hear some of the discussion on raw materials, so with your permission we might jump to chapter IV.

The first question is, What does the current revision in the declassification guide really mean in theory and practice?

There has been quite a bit of discussion of this concept of whether atomic information is "born" classified or born declassified. With the current broad scale of revision in the guide, particularly relating to reactors, is there any information in this field that is born declassified?

Mr. FIELDS. I would like Mr. Marshall, the head of our Declassification Division, to answer that question, sir.

Mr. MARSHALL. There is, Mr. Chairman, some information which now by Commission action will not require a classification at its origin. Perhaps I could start by saying that the information that is declassified by the new declassification guide relates to all phases of

nuclear power, starting with ore recovery and going through to the chemical processing, that is, the chemical recycling of spent fuel elements.

The latest action will permit declassification of a large quantity of the information which up to now was only available through access permits.

Now, more than 80 reactors, either in the design concept or in the thinking stages, that is people have told us they have wanted to build a reactor, or are thinking of building a reactor of a certain type, have been declassified by project, which means that the reports that will be written with respect to these reactors will in themselves not require any classification even at their origin.

This information will be born unclassified.

Of course, to suggest the answer to the question that you asked about the born classified, under the law as it is presently written new information must be born classified.

The law calls it restricted data and specific action is required by the Commission to remove it from restricted data.

This is a very good provision. I think there is no other way in which security of information can be preserved. You could not possibly maintain security on any information affecting the national defense without having it come into being classified and then be released from this after consideration of its value.

Closely related to the reactor data which I mentioned a minute ago will be declassification of the technology of heavy water manufacture, the separation of zirconium and hafnium and also the liquid thermal diffusion process for isotope separation.

Uranium mining operators, underwriters, investors, in the United States and in other uranium-producing countries, will benefit by the removal of all restrictions on the publication of statistics for the overall uranium-ore reserves and the present and future concentrate production figures.

The information that will be released under the new guide will also provide a much broader practical basis for enriching and improving high school, college, and univerity curricula on nuclear science and engineering; textbook publishers will be able to produce new up-to-date text and general study aids on nuclear-energy application.

A like opportunity is provided for the general technical and the business press to provide a wider scope of information to those readers who need to know more about nuclear energy and its uses.

Information which is primarily applicable to military propulsion reactors, production reactors, and to weapons will continue to be classified.

Representative COLE. A facility that is designed for the purpose of producing radio isotopes is one which requires a license?

Mr. FIELDS. Yes, sir; that is right.

Representative COLE. Would it require the same degree of policing on the part of the Commission with respect to inspection, supervision, control, that other types of facilities require?

Mr. PRICE. Mr. Cole, it requires the same kind of evaluation and the same kind of protection.

Now, obviously, a small research reactor may not create as difficult a problem of hazard evaluation as another type.

Representative COLE. What I am wondering is, whether the law is unduly restrictive with respect to the commission's responsibility in policing an isotope reactor or if the Commission has sufficient latitude to relax its inspection and control and supervision of isotope reactors.

Mr. PRICE. Based on the experience to date and, of course, this does not involve a large number, but we have had facilities all the way from the small critical experiment facilities which are a reactor on up through research, testing and power reactors—I think it would be our view that we have sufficient flexibility.

I don't think we would want to impose different kinds of controls because the inherent hazards are the same kind; they are just a different order of magnitude.

Representative COLE. You do not see any undue restriction in the law with respect to what might be termed an "innocent atomic reactor," such as one that only produces isotopes?

Mr. PRICE. I would think, on the basis of the problems we have had to date, we have not found any difficulty in the law in that respect.

The CHAIRMAN. How about research reactors? You have some of those which use isotopes?

Mr. PRICE. They could produce some small quantity of isotopes, but I think the same answer applies.

The kinds of hazard problems, safety problems, that we look at in any reactor are present. The research reactor does not create the problem of the possibility of as large a release as the big power reactor.

On the other hand it is constantly being experimented with so in that sense it has some special problems that a power reactor does not have.

So the licensing problems are the same. It just happens that some of those problems get greater emphasis in one type of facility than in another.

The CHAIRMAN. But it is possible to have a research reactor in a college and, of course, have some classification on it; is that true?

Mr. PRICE. It is possible that a college would do some classified work. I do not believe that any of the information relating to the design and construction of research reactors is now classified.

The CHAIRMAN. Some of the work could be classified?

Mr. PRICE. Conceivably they might do some classified work; yes, sir.

Mr. RAMEY. How long will it take to complete the currently expedited declassification review of classified documents for industry?

Mr. MARSHALL. We expect that the review program which is now in process will be completed by the 1st of April.

Mr. RAMEY. About how much of the presently classified material will be downgraded and how much will be declassified altogether?

Mr. MARSHALL. In percentages of documents that are concerned with civilian power reactors, we have so far been able to declassify about 80 percent of the civilian power reactor documents. Of the remaining 20, about 10 percent have been downgraded and the others have remained secret, because of extraneous material that was introduced into the document by the authors.

These people who wrote the documents did not write them strictly about their own reactor, but they introduced or included in their reports information concerning classified reactors which therefore renders the report classified.

In 80 percent of the cases, however, this did not happen and we have been able to declassify the report completely.

Mr. RAMEY. Will there be any attempt, or has there been any attempt, to review the material, weed out old and inaccurate information, and compile the valid information into usable form for industry and the public?

Mr. FIELDS. Mr. Thompson, who is from the Division of Information Services, will answer this question.

Mr. THOMPSON. As is the Commission's custom, we have a program following quite closely the declassification program.

It is really a sorting and writing program. All the documents reviewed by the special classification task force are being currently evaluated in terms of their significance and current usefulness.

And while all the documentary material will be listed and made available, the most useful will be reprinted, listed, and abstracted separately on a priority basis.

The less useful documents from a technical viewpoint are being identified as obsolete and erroneous and otherwise, but they will be made available when requested.

Documents are evaluated by members of the special review group, by literature specialists of the technical information service, and where appropriate by originating sites.

Recently declassified material will be incorporated also into the expanded book series which is described in the submitted 202 material.

This program the Commission is undertaking to meet the needs for new texts useful to industry. It is felt the Commission's effort to compile existing information into summary volumes plus technical progress review series, also described in the section 202 material previously supplied to you, provides up-to-date information on peaceful uses of atomic energy in a most usable form.

Mr. RAMEY. One further question: Could you describe a little more in detail your mechanism for transmitting your technical information out of your laboratories and plants such as Bettis and Argonne and others, from your actual projects to industry? How is it generated and what is the means of getting it out to industry and the public?

One problem that has been discussed to some extent informally, is whether, for example, a particular laboratory would want to release certain technical information until it is sure that the laboratory can put its name to it and say it is the best information there is available.

Do you have any way of pushing that information out of a place?

Mr. THOMPSON. Well, the scientist is always loath to turn out a partial conclusion. He would rather do a finished paper and turn that over to the Commission.

We are making an effort to encourage them to let us have useful information even though it may be in the form of informal memoranda. The value of such memoranda will vary a great deal.

Our technical information people consult very closely with the various parts of the project, the different contractors and others, and endeavor to provide some guidance to them as to the kind of information that we feel should be made available to us for broadcast through the project and out to the access permittees.

I think that we are making some useful progress in this direction and the inhibition of the scientists is somewhat broken down by the

fact that we very carefully describe the incomplete report as an incomplete report with no suggestion that this represents the final thinking of the originator.

(See AEC correspondence, p. 775.)

The CHAIRMAN. Next, we will go to V, manpower base for atomic energy industry.

Mr. RAMEY. One problem that Senator Pastore discussed on our field trip to various AEC installations this December, was the matter of training high-school teachers in atomic energy work.

Does the AEC have any program or activity in the training of high-school teachers in the elements of nuclear science by such things as summer refresher courses?

Mr. FIELDS. We do have some courses of this nature. I would like Mr. Hodgson, who is Deputy Director of our Organization and Personnel Division, to answer this question.

Mr. HODGSON. Mr. Chairman, we have for the past 2 years, and do plan for the coming year to conduct what we term "summer institutes and secondary school science teaching." The past year, as I recall, we had 96 teachers who participated in this program.

This is one of a series of programs which are directed toward the high schools. They include radiobiology training courses which have been sponsored through the collaboration of AEC and the National Science Foundation at Duke University, Harvard University, and the University of New Mexico.

In addition to the summer institutes which I mentioned to you, the third one, beginning this coming summer, there is a high-school demonstration program which is conducted by the Commission and which as of June 30, 1956, has been conducted at 222 high schools reaching 148,000 high-school students. This program is booked to cover 490 high schools and approximately 300,000 students during the current fiscal year.

In addition to that there is the traveling science demonstration lecture program conducted by ORINS out of Oak Ridge, which consists of high-school teachers—eight, I think, is the correct figure—who are traveling around visiting high schools and putting on demonstrations. I understand 200 high schools in 48 States have been visited in this program.

The last item that I have here is the program that is carried on at the University of California Radiation Laboratory in Berkeley, which has given 2 training courses, consisting of 8 weeks during the summer, directed to high-school science teachers in the area served by Berkeley.

Mr. RAMEY. Does the Commission believe that mathematics teaching and scholarship of students is a problem in terms of the availability of trained manpower?

Mr. HODGSON. I should like to answer in this regard, sir:

The Commission does feel, of course, that mathematics is basic to the nuclear sciences. From this point of view we are very much interested in the teaching of mathematics and the improved teaching of mathematics in the high schools and similarly, of course, in the colleges.

I do not think I can add anything to that, sir.

Mr. RAMEY. Congressman Price and Senator Pastore introduced legislation based on hearings held last year, and particularly the testimony of Dr. Rabi, that would encourage students to go into mathematics and in that way to possibly improve mathematics teaching. What does the Commission think of this Price-Pastore bill?

Mr. FIELDS. I do not believe we are in a position to state today what the Commission thinks of that particular bill.

My personal opinion is that mathematics is the queen of the sciences and is a necessary science. I do not know how generally the governmental approach to education and the fostering of it applies; whether this is the type of bill or not.

To answer your question specifically, I am not in a position to state what the Commission's comment would be on that bill today.

The CHAIRMAN. We will go to chapter VI.

Mr. RAMEY. The committee has been impressed with the recent progress made in obtaining private participation in the feed materials program and over the last several years with respect to the procurement of reactor materials such as zirconium and beryllium.

As a means of explaining how this private participation has been obtained, would it be possible to describe the methods of bringing in private industry, say, in the zirconium business, for example?

Mr. FIELDS. I would like Mr. Davis, the Director of Reactor Development, to answer that question, Mr. Chairman.

Mr. DAVIS. With specific reference to the zirconium program, early development work was started on zirconium as a possibly useful material for pressurized water reactors sometime in 1948, possibly even a little work in 1947 and really got underway as a materials development program about 1949.

In this early development program there was quite a bit of work done by the Bureau of Mines, some by the Argonne Laboratory, a great deal by the Bettis Laboratory, and some by Ames and Y–12 at Oak Ridge, which was primarily a program to develop the methods of production of zirconium and the methods of hafnium separation to make it useful for reactors.

This program, of course, not only developed these methods, but also produced some material which was used, including the material used in the Mark One core for the Idaho STR.

In 1951 the requirement for reactor grade zirconium indicated that the capacity of the existing Government-owned facilities which were pretty much of a pilot-plant nature, would be exceeded and steps were taken to encourage private industry to produce zirconium metal to AEC specifications on a unit price basis.

The CHAIRMAN. What is that unit price?

Mr. DAVIS. Well, here we are trying to get, of course, for a specified amount the lowest number of dollars per pound of zirconium.

My recollection is that this figure started out in the very early days as something like $150, or $200 a pound.

Today it is down in the neighborhood of $8 a pound. So this has been the overall reduction by this program.

In July 1951, we got together 32 companies who were interested in supplying zirconium with representatives of the AEC. These companies were told about the problems involved in the manufacture of reactor grade metal and of the procedures for obtaining access to

classified information on the Government developed process which, of course, was classified at that time in 1951.

In November of 1951, invitations were issued for bids for delivery of zirconium sponge in an amount not exceeding 300,000 pounds annually for a period of 5 years. Bids were requested by January 15, 1952.

We received no bids which were responsive to this invitation.

In order to determine whether practical quotations might be obtained by negotiation, a contract board was established in the Chicago operations office to discuss with firms showing initial interest the most satisfactory terms and conditions on which a 5-year contract might be negotiated.

In March 1952, negotiations were authorized with 2 companies recommended by the board from 8 different firms which were visited by the contract selection board. These negotiations resulted in the award of a contract to the Carborundum Metals Company of Akron, N. Y., for the delivery of 200,000 pounds of zirconium annually for 5 years.

This met our needs then for sometime. Finally, in August 1955, the increasing requirements, particularly for the naval reactors program, led to plans to procure an additional 2 million pounds of zirconium annually over a 5-year program.

Preliminary schedules and further information were sent out in a prospectus for procurement of zirconium which were sent to 344 possible suppliers.

In November 1955, we asked for formal proposals and sent these announcements of this request to 56 companies out of the 344 which had indicated an interest.

The CHAIRMAN. If I were to build a reactor, how would I get zirconium?

Mr. DAVIS. It would depend upon whether you were building one as a part of an AEC program or privately.

The CHAIRMAN. I am speaking of a private organization.

Mr. DAVIS. Then you would go to one of the companies and arrange to purchase zirconium directly from them.

Mr. RAMEY. Does AEC encourage these private manufacturers to have excess capacity that they can sell to private industry as well as to the Commission for its account?

Mr. DAVIS. Yes, sir; very definitely.

The CHAIRMAN. That same procedure will apply to all the other materials?

Mr. DAVIS. Well, it has perhaps been developed further for zirconium for the moment than for some of the other materials because of the very widespread potential uses of zirconium.

The CHAIRMAN. You are using it all at the present time and that means that private enterprise would not be able to purchase it?

Mr. DAVIS. No; there would be adequate capacity. We have pointed out that we have awarded contracts to three companies for the annual delivery of 2.2 million pounds per year.

In the meantime, however, because our demands are growing at such a rate, in the 18 months or so it will take them to get these new facilities into operation, we have made 3 interim arrangements in order to obtain more zirconium in this intervening period.

One of these is an expansion of existing capacity at Carborundum. One is the operation of the Bureau of Mines, at Albany, Oreg., by Wah Chang Corp.

Another is the purchase through Commodity Credit Corporation of zirconium from Japan.

Now, the 3 companies who presently are engaged in building plants, it is our understanding, will have considerable excess capacity over the requirement for the 2.2 million pounds per year required by the Commission.

The CHAIRMAN. Is Japan producing zirconium?

Mr. DAVIS. Yes, sir.

This in brief is the history of the development which, as I say, has resulted in a reduction of price from roughly $200 a pound to the order, I believe, of $8 to $9 a pound.

The CHAIRMAN. You have done a pretty good job on that. I want to congratulate you on that.

Mr. RAMEY. On this question of reprocessing, on page 14 in regard to AEC provision of reprocessing services, it is stated—

> In order that such services may be furnished to private industry at reasonable prices, however, difficult problems are involved.

What are they? Would it mean, for example, constructing additional processing plants?

Mr. FIELDS. I would like Mr. Bloch, the director of our Division of Production, to answer that question.

Mr. BLOCH. That statement, Mr. Chairman, was in the context of our efforts to interest private industry in constructing and operating chemical processing plants. We have been exploring this problem for a good many months. One of the major problems seems to be whether or not there is a sufficient volume of fuel that would be coming back from power reactors during the early years, that is, during the early 1960's, to support an economical processing plant operation.

The Commission is prepared to offer, in order to assist on this problem, a base load consisting of Government-owned fuels, but even with this base load there is still the question of volume.

And projecting the problem, volume is complicated because the volume is so much a factor of the actual burnout that a core will give in a reactor. The volume of material to be processed can vary in almost direct proportion to the length of time that a core or charge can be irradiated in a reactor.

Another problem is the State of the technology with respect to certain of these fuel elements. Many of them are new and involve process development work or modifications. They involve alloys and jacketing materials with which we have not had any prior experience.

Our development work is going on, but in some instances the state of the art is not very far advanced and this, of course, would involve an added risk on the part of a private concern constructing a facility.

Another problem which we are discussing with interested industrial concerns is the one of waste disposal and here the question is basically whether any company could assume an indefinite responsibility for custody of radioactive waste, or whether, even though he might assume custody for a period of years, at some point he would have to be relieved of this liability.

These are the major problem areas that we see at present and we are continuing to study them, not only ourselves, but also with various industrial concerns who are interested in this aspect of the business to try to come up with some answers.

(Pertinent correspondence from AEC, follows:)

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington, D. C., February 11, 1957.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. DURHAM: One of the major uncertainties in the economic evaluation of nuclear power concerns the cost of chemically processing spent reactor fuels for recovery of valuable residual materials. These costs cannot be ascertained by potential reactor operators either from private industry, which has so far made no firm plans to enter this area, or from the AEC, which, because of technological uncertainty, has so far been prepared to furnish only estimates of processing cost, rather than established charges.

We believe that a reduction of the uncertainty in this area will contribute significantly to the advancement of nuclear power both here and abroad. Accordingly, the Commission has adopted a policy which will permit the making of contractual arrangements with reactor operators, under which the Commission will provide for processing services at firm prices, based on the Commission's full cost recovery policy as applied to an assumed plant capable of processing all the types of power reactor fuels of current interest.

Under the conditions of this policy, AEC will establish by contract with reactor operators firm charges for the processing of spent fuel. The charges will be based upon the estimated cost of such processing as determined by AEC and all fuels will be charged for on a common basis. The charges will be subject to escalation in accordance with an appropriate recognized price index. In the event it becomes necessary for the AEC to construct new processing facilities and major technological improvements that would result in lower costs than those established should develop in time to be incorporated in such facility, consideration will be given to downward adjustment if operating experience establishes that these technological improvements have resulted in a reduction in the estimated cost of processing.

Contracts will be entered into, upon request, with reactor operators for a term extending to June 30, 1967, except that each contract will reserve the right to AEC to terminate the contract without liability effective no less than 12 months after AEC finds that processing services will be available from private sources at reasonable prices.

The Commission also intends to provide processing services for foreign reactors fueled with United States material, at the same charges available to domestic licenses. In connection with the furnishing of services and materials other than special nuclear material to foreign reactor projects, the Commission has acted to extend its full cost recovery pricing policy to the furnishing of materials and services abroad under agreements for cooperation.

A brief unclassified press announcement and Federal Register notice concerning this policy which will provide you with further details are under preparation and will be furnished to you prior to issuance.

We shall be pleased to answer any questions you may have on the subject.

Sincerely yours,

LEWIS L. STRAUSS, *Chairman.*

The CHAIRMAN. No. VII.

Mr. RAMEY. On page 2 of your statement on your full cost recovery policy, it is stated that:

For miscellaneous service and material which the Commission must furnish in the absence of adequate commercial sources of supply, the Commission has continued to follow the policy of charging full cost or a higher going commercial rate if appropriate to avoid discouraging the development of sources of supply independent of the Commission.

What are the services and materials for which the Commission charges a higher going commercial rate and how do you determine what that higher going commercial rate is?

Mr. FIELDS. Mr. Chairman, I would like the Controller, Mr. Burrows, to answer that question.

Mr. BURROWS. In answer to the specific question, there are no services and materials which are now selling at a higher commercial rate with one possible exception. We occasionally have a request to do minor miscellaneous services such as photographing documents, in which case we charge the going commercial rate for those kinds of services.

Insofar as how we find out what the going commercial rate is, this is either known to us through standard practice or we would make an appropriate survey to find what the competitive going rate would be.

Representative HOLIFIELD. I would like to know how you apportion AEC overhead and so forth? Do you have a regular formula for that which takes into consideration the number of people working on a particular project? How do you go about knowing how to make a correct charge which will at least let the Government break even on that type of thing?

Mr. BURROWS. Mr. Holified, we have an established cost system in each of our contractor's organizations which we use for our own purposes in measuring cost. It is through this system we are able to identify the costs which are applicable to a given product or service.

This involves director labor, direct materials, and appropriate pro ration of any overhead, including a charge for applicable depreciation on the facilities.

Representative HOLIFIELD. Now, these services and materials, there is a genuine attempt on your part to at least replace the cost the Government has incurred in making your charges?

Mr. BURROWS. Yes, sir.

Representative HOLIFIELD. What principles did you use for the establishment of guaranteed prices for special nuclear material?

Mr. FIELDS. I would like Mr. Price, the Director of Civilian Application, to answer this question.

Mr. PRICE. Mr. Holifield, we established and announced a guaranteed fair price on the buy-back of plutonium and U–233 from privately owned power reactors, the figure of $12 was announced for plutonium, $12 per gram, $15 per gram for U–233.

Now, these prices took into account, as the law requires, the intended use of this material. These prices for these two materials are based on their value as reactor fuel.

Now, having related it to value for fuel in a reactor, having made that determination, we then relate this material to the value of U–235 for fuel, taking into account the fact, in the case of plutonium that plutonium is a less efficient energy source than U–235.

So what we in effect are saying is that we have announced a schedule of charges for U–235 as fuel for reactors, that those charges are based on full cost recovery for U–235.

Then we said we will pay for plutonium and U–233 a value for use as fuel that equates those two materials to U–235.

Representative HOLIFIELD. In terms of respective thermal unit production? You say you are using it as fuel and the purpose of fuel is to produce thermal units?

Mr. PRICE. That is right.

Mr. FIELD. It is really in terms of their comparative value as we can now estimate it. Is this not correct?

Mr. PRICE. That is right. It is an estimate of what plutonium would be worth as fuel competitive with U–235. That is right.

Representative HOLIFIELD. There is no attempt to put an arbitrary weapon evaluation on plutonium?

Mr. PRICE. This is purely fuel value. Of course, there is in existence a classified price schedule which we cannot talk about.

Representative HOLIFIELD. I was going to ask if these contracts for buy-back are on terms of a 7-year period?

I want to find out two things: If these contracts for buy-back are issued on the basis of 7-year contracts. If so, when did they begin and have there been revisions upward or downward in the price over the last few years?

Mr. PRICE. No. 1, the guaranteed fair price on the buy-back is a guaranty for 7 years from the date of the guaranty. It has nothing to do with the time when a company would start delivering materials.

Representative HOLIFIELD. In the third round, did you not change that?

Mr. PRICE. No, sir.

Representative HOLIFIELD. You did not change that?

Mr. PRICE. No, sir.

In 1955, I guess it was along in the middle of 1955, we published a notice of the establishment—it was classified then—of a guaranteed fair price on the buy-back and this was for 7 years from that date.

Then in 1956 we added another year. At that point we declassified and announced publicly the $12 fuel value price for plutonium and $15 for U–233.

Mr. FIELDS. The current schedule carries that guaranteed buy-back price to July 1, 1963, for whatever contractor it is.

Representative HOLIFIELD. There is no thought on the part of the Commission of maintaining that particular price level. If the condition of our need changes, you would make new contracts at either increased or reduced prices, according to the need?

Mr. PRICE. We cannot reduce that under the law.

Representative HOLIFIELD. I do not mean the ones you have contracts with. I am talking about new contracts. If you make new contracts with new people that would carry beyond 1963, you would be free, then, to change the price, would you not?

Mr. PRICE. Mr. Holifield, these are not contracts. These are determinations that we make under the statute fixing the price that will be paid to all comers. They do not have to have a contract with us to get this price.

Representative HOLIFIELD. Maybe I used the wrong word, but it is a valid agreement on the part of the Government which you would stand behind as though it were a contract?

Mr. PRICE. That is right. We are bound to take all the plutonium produced at a fair price and all the U–233 that is produced regardless of whether it is straight licensing or whether we have a contract. But we have not determined, to answer specifically, what the price will be beyond 1963.

Representative HOLIFIELD. But between now and 1963, if the need occasioned a change either upward or downward, you would announce new prices and that would only be applicable to the newcomers to the market and it would not necessarily be retroactive?

Mr. PRICE. It would be applicable to material delivered beyond the 7-year period. It would be applicable to the old comers and new comers on material delivered after this present 7-year period.

Mr. FIELDS. Is there not one further statement to make though? In the time between now and July 1, 1963, which is the current guaranteed time period of the schedule, if we found the value of the material to be more than the published price, we could raise it, I understand.

We cannot lower the price for this period between now and 1963. We can lower it for the next year beyond 1963, from 1963 to 1964 in the extension of this schedule, if we wish.

Representative HOLIFIELD. Then am I to understand from what you have said that the 7-year bracket is a fixed price which could be raised, is a guaranteed minimum, and if it was raised during that time it would be applicable to the people now producing and the people who plan to produce?

Mr. PRICE. That is right, during the period it was made applicable.

Representative VAN ZANDT. General Fields, what is the cost of the isotopes you make available today to industry?

Mr. FIELDS. I am not sure I understand your question, sir.

Representative VAN ZANDT. What are you charging industry for the isotopes? Are you charging the actual cost of producing them?

Mr. FIELDS. We are charging on the basis of a full cost recovery.

Representative VAN ZANDT. Does that apply to industry in general?

Mr. FIELDS. Yes, sir.

Representative VAN ZANDT. How about the field of medicine?

Mr. FIELDS. In the field of medicine in the isotope region we do have a discount there on the full cost of the isotopes that are distributed. It is 80 percent discount, 20 percent of the actual cost, sir.

Representative VAN ZANDT. To what extent has industry entered into the production of isotopes?

Mr. PRICE. Industry has not yet entered into the production of isotopes. As we mentioned in the report, we think there are good reasons why it will be feasible and economically feasible for industry to enter into the production of isotopes in the next couple of years.

For example, as we mentioned earlier this morning, there is the problem of cobalt 60, an industrial demand is building up. We are now producing three to four hundred thousand curies a year that are distributed for research and development. Now, to meet industrial demand for megacurie quantities at a price that the industrial people want to pay, we think in the next couple of years there will be a place for a privately owned reactor to go into that business, just based on the demand that is building up.

Mr. FIELDS. Mr. Van Zandt, there are some universities who operate cyclotrons. If you are talking about pile-produced isotopes, I think that is the answer, but there are some universities that produce some isotopes in cyclotrons and other machines.

As I understand, they use them in their research programs. I do not know that they sell them extensively. There are firms that take isotopes. They buy from us and process them in a form which is

used in industry. You probably know, I believe it is about the Abbott Laboratories that takes them right from the Oak Ridge reactor, packages them in a form that they can be sold to doctors and hospitals.

There is a good deal of effort in that field that is a commercial effort, the adaptation of the isotopes so that they are usable.

Mr. PRICE. I think in the report it mentioned that there are upward of a hundred companies doing that kind of processing of isotopes after they are produced in the Commission reactor.

Representative VAN ZANDT. Has the Commission found it necessary to deny any request from business, including medicine, over the past several years that would assist them in the production of isotopes?

Mr. PRICE. No information denial; no, sir.

Representative VAN ZANDT. How about materials?

Mr. PRICE. On materials, I think perhaps there have been some requests for large quantities of cobalt 60, and perhaps some other materials, that we have not been able to meet.

Mr. FIELDS. And we get requests for special types of isotopes not normally made, and we sometimes have difficulty supplying that kind of request.

Mr. PRICE. A person will want a small quantity of an isotope in a particular form, where to produce to his specifications we would have to charge him a price that he just is not willing to pay. We have had cases like that.

Representative VAN ZANDT. Where you received a request for material and you denied same, can you give the reasons?

Mr. PRICE. Well, the kind of case I just gave you is not really a denial. It just meant that the material was not available. I think perhaps there have been some requests for megacurie quantities of cobalt 60, for example. To make it feasible for the company, it would have to be at a price less than our present full cost recovery and we just have not been able to meet those requests either on the price basis or on the availability of materials.

Representative PRICE. What would you have to do to meet those requests?

Mr. PRICE. We either would have to build facilities ourselves or supplant some of the production of other materials in our production reactors. In other words, we would have to use the space in the production reactors to meet them.

Our thought here is that we are just about in a position where the economics are such that private industry ought to be able to pick this up. That is what we propose to try to do.

Representative VAN ZANDT. Have you any planning afoot now that would relieve this situation? We have been told here that industry has enjoyed returns to the extent of a billion dollars as a result of the utilization of isotopes.

Now we are told in hearings last year before Mr. Price's subcommittee that isotopes were not available to various efforts. What we are trying to clear up here is when you are going to solve this problem so that the isotope is available to anybody that wants it in this country so that we can get full benefit of peacetime use of atomic energy?

Mr. PRICE. I do not know how to answer the question of when. We feel there is enough interest on both sides of this problem of industrial

uses of materials in large quantities like cobalt that private industry will find it economically feasible within the next year or two to go ahead.

As a matter of fact, there are some companies that are deep in planning on this right now. As I mentioned earlier, we cannot say that somebody has made a firm plan or definite decision and committed money to build a plant, but there are companies looking hard at it and that is our objective, to find a way to get them into private production early.

Mr. FIELDS. One of the measures taken a year or so ago had to do with the construction of a plant at Oak Ridge to separate some of these isotopes. This should go into operation, I believe, this year, for separation of cesium; I believe strontium 90 is also in it.

Some of these isotopes and figures on products should be of great value in the distribution of isotopes.

The CHAIRMAN. We will now go to No. VIII.

Mr. RAMEY. On the nuclear reactor field, the first question is, does the Commission favor fixed price contracts for the development and construction of reactors?

Mr. FIELDS. Mr. Davis, the Director of Reactor Development Division, will answer that question, sir.

Mr. DAVIS. This depends considerably on the circumstances, Mr. Chairman. I think we would favor fixed price or at least ceiling price for the purpose of getting the maximum incentives for cost reduction in those cases where it is possible.

Whether this is a feasible thing to do or not depends on the purpose of the reactor and to a very considerable extent on its size and, therefore, its cost. We certainly do not think it would apply generally, except for components or things that would be bought under fixed-price contracts, for things such as reactor experiments which are highly experimental in nature.

Again, it may not be feasible for very large experimental prototypes, particularly when they are of a fairly advanced nature. So we feel that it should be feasible, at least in terms of the ceiling cost, if not a fixed cost, for small reactors and have urged this in connection with the power-demonstration program where we feel we are basically applying technology to building prototype commercial reactors. Probably I should point out that, even in our own AEC work, through the authorization procedure, where we have a percentage limit on it, we are in effect operating under a ceiling price, too.

So I think my answer is really that we think this is a useful thing under some circumstances, and where it is feasible.

Mr. RAMEY. Based on your experience, do you think anybody is making any money on these fixed-price arrangements, even for components on the developmental reactors?

Mr. DAVIS. I do not know quite how to answer that, Mr. Ramey. I think there are probably some components which are being sold at a profit, and there are others which are being sold without any profit or even at a loss. I do not think there is a general answer to that question.

Mr. RAMEY. Has there been much of what you would call "buying" into the program in terms of making low proposals on a fixed-price or ceiling-price basis in order to get the order, and then it turns out that they may lose money, or they are losing money?

Mr. DAVIS. I think there may have been some of this. I think it is not particularly prevalent because I think they realize that to sell something at a low price and then to have to go back later and raise the price is not a very good way to get business.

Mr. RAMEY. It is not possible, is it, under a Government contract?

Mr. DAVIS. I mean for successive, for later items of the same type. I think there may be quite a few cases where people have bid on components of plants, figuring the price pretty close, and they have found later after they had gotten into the development and manufacture of the item that it actually cost more than they anticipated.

The CHAIRMAN. Do you know of any private company today offering reactors at a fixed price to the purchaser?

Mr. DAVIS. Yes, sir.

The CHAIRMAN. There are people doing that?

Mr. DAVIS. Yes, sir.

Mr. RAMEY. Power reactors?

Mr. DAVIS. Yes, sir.

The CHAIRMAN. Research and power?

Mr. DAVIS. Research and power reactors. Small ones in most cases.

Mr. RAMEY. Does the Commission still favor fixed limits on its contribution to demonstration projects?

Mr. DAVIS. It is assumed we are thinking here in terms of the research and development contribution rather than the construction costs.

Mr. RAMEY. Or both, where you do have a construction cost.

Mr. DAVIS. In general, I think this again depends somewhat on the size of the plant, but generally we have tried to establish a ceiling cost or a fixed cost so that we would be able to know what the AEC commitments are in a particular project. Now actually all of our development work, as such, is essentially set forth by the amount that we plan to spend in a given year so that really the estimate of a ceiling cost depends upon the length of time you are working on a project and in the case of the power-demonstration program we felt that the aim of this program is to apply technology which has already been fairly well developed and, therefore, if one can estimate the time and the development work that it is reasonable to establish at least ceiling cost for the research and development.

Mr. RAMEY. Is that working out in practice, in your experience?

Mr. DAVIS. I would say it is working out in most cases or a large number of the cases fairly well.

Mr. RAMEY. You mean that the actual research and development costs are staying within the estimate?

Mr. DAVIS. You are talking now about power-demonstration programs?

Mr. RAMEY. Yes, sir.

Mr. DAVIS. I do not think we have gone far enough on those to have enough actual cost experience to say. Certainly some of the proposals that we have received have been of such an exploratory nature that it is hard to see how you can tie down the research and development cost.

Mr. RAMEY. I think what is back of these questions is that the effect of these fixed-price contracts and the fixed contribution of the Commission is to put the whole risk on the equipment industry, and

that when their costs on research and development programs, as always happens on research and development, go up, then they are the ones who generally have to absorb those losses. The equipment company or in the case of a private power company or the co-op they are dealing with, will have to either share the loss or the power company or the co-ops absorb the loss by itself.

Mr. DAVIS. We have tried to urge that, in making proposals to us, they be realistic about these costs, but have felt, in order to get the maximum out of a project of this nature, which is primarily an application to a commercial plant, that we would get the most value out of this if they were working with some cost ceiling.

Mr. RAMEY. What is the average fee for the Commission's own research and development work that it does on a cost-plus-a-fixed-fee basis?

Mr. DAVIS. I don't believe it would be useful to discuss an average fee since the fees that we pay people for this type of work depend a great deal on the size of the contract, the type of the work, and upon the actual circumstances. We do believe we have reasonable fees, although we believe that they are modest. We do get people to do the work and do not have very much trouble with negotiating the fees. There are some people who do complain about the fees; not very many of them. I think it is our feeling that, if no one complained, we might be paying them too much fee.

Mr. RAMEY. I think it is well known that the Commission has the reputation for bargaining rather low fees due to Mr. Tammaro and other people in the past, and I think those fees are known in terms of the general formula used, that they are not what you might call business confidences.

Mr. FIELDS. I am under the impression that we have never revealed these in open hearings, Mr. Ramey. They may be generally known, because a contractor compares notes with another one as to what we have paid in a fee, but we have never published a fee schedule that we might be aiming toward, that I know of. We publish the actual amount that is paid any particular contractor after the negotiations and so forth, which is slightly different than publishing the schedule.

Mr. RAMEY. I think the fee schedules for particular contractors have been published, to my recollection.

Mr. FIELDS. I would like the opportunity to check this, if I could.

(The information referred to follows:)

The Commission has not published fee schedules or formulas used by Commission personnel in negotiating fees. However, the amounts of fees paid to particular contractors have been announced on various occasions, or have been made public on request.

Mr. RAMEY. Of course, the next question was whether these fees for research and development work may be too low under the present circumstances in that the original fee schedules, as I understand it, were based on Oak Ridge experience to a certain extent and took into account, I think, the aspect that industry was going to get some know-how from the atomic energy development work that they were doing.

At the present stage of development, at least, it has been suggested by some that, with the current situation of industry not making much money on the private side and going into private development work,

they will not get quite as much know-how under the present circumstances and possibly fee schedules might be reexamined to pay somewhat higher rates.

Senator GORE. Only this morning information came to me with respect to the fees paid by the Commission on several contracts. I do not wish to reach a hasty conclusion, but I must say that for cost-plus fees, they appeared to me preliminarily as unconscionably high.

I think this is a matter that we need to go into with greater care than has been the case heretofore.

Mr. RAMEY. Were those on reactor development contracts?

Senator GORE. They were from different types of contractors. I was not confining my remarks to the specific subject of your inquiry. As a matter of fact, this was information on a number of contracts of different categories.

Mr. RAMEY. The next question is, Has industry made any proposals concerning development and construction of reactors for industrial process heat?

Mr. DAVIS. We certainly have not received any formal proposals that we should build such reactors. We have discussed this as a possibility for a power demonstration type of approach. It is so indicated in the release that was put out on that. We have had a series of discussions stretching back over several years with various people who have been interested in the use of reactors to produce either process heat at low temperatures for various purposes, including in some cases heating, and have had during the last 2 years, I would say, still further discussions with various people on the use of reactors for very high temperature processing and are doing some study work and development work in this area, although it is quite clear this is still a long-term proposition to develop reactors that will produce heat at the temperatures that people are interested in for this application.

The CHAIRMAN. It is very evident the fifth question on No. VIII would require a considerable amount of time to answer. I wish the Commission would supply the answer to No. 5 at a latter date so that we can put it in the record.

Mr. FIELDS. We will be happy to do that, sir.

(The information referred to follows:)

SECTION VIII. PROGRESS IN THE NUCLEAR REACTOR FIELD

Question No. 5. Please provide the figures on the original estimated cost and completion date and the actual cost and completion date or currently estimated cost and completion date for power reactors involved in (*a*) the 5-year experimental program, (*b*) the first and second round demonstration program, (*c*) the privately financed licensed program (*d*) the Government-sponsored Shippingport project?

1. The costs shown include cost of plant construction and the costs associated with the fabrication or preparation of fuel elements (when this data is available). The cost of the related research and development program and operating costs are not included.

2. The "original" costs shown for the 5-year program are taken from the report submitted to Chairman Price of the Subcommittee on Research and Development, JCAE, on July 11, 1955. The current costs shown for this program are the most recent figures available.

3. The original costs shown for the power demonstration reactor program are based upon the proposals which were approved as a basis for further negotiation by the Commission. The indicated current costs are based upon the most recent available figures.

4. "Latest" cost figures shown for privately funded projects are the most recent publicly announced figures.

FIVE-YEAR PROGRAM

Pressurized water reactor (PWR) Shippingport, Pa.[1]

Original estimate of initial low power operations, July 1957
Current estimate of initial low power operations, December 1957

Original estimated cost:	Thousands
Reactor plant	[2] $37,750
Turbine generator	10,000
Total	47,750
Current estimated cost:	
Reactor plant	[2] 55,000
Turbine generator	15,000
Total	70,000

[1] See also letter (p. 694).
[2] Includes a $5 million investment by Duquesne Power & Light Co. in the project and a $0.5 million contribution by Westinghouse Electric Co. Includes cost of the initial core, buildings, and supporting facilities. The original estimate included $10 million for the initial core; the current estimate includes $13 million for initial core.

Boiling water reactor (BWR) Argonne National Laboratory

Original estimate of initial low power operation, December 1956.
Initial low power operation, December 1956.

Original estimated cost:	Thousands
Reactor fabrication	$2,600
Fuel fabrication	900
Building and supporting facilities	1,000
Total	4,500
Current estimated cost:	
Reactor fabrication	3,945
Fuel fabrication	1,195
Building and supporting facilities	1,000
Total	[1] 6,140

[1] Project physically completed but financial closeout not yet completed.

Homogeneous reactors (RHE No. 2), Oak Ridge National Laboratory

Original estimate of initial low-power operations, June 1956.
Current estimate of initial low-power operations, December 1957.

Original estimated cost:	Thousands
Reactor fabrication	[1] $1,800
Fuel preparation	([2])
Building and supporting facilities	[3] 630
Total	2,430
Current estimated cost:	
Reactor fabrication	[1] 3,000
Fuel preparation	([2])
Building and supporting facilities	[3] 630
Total	3,630

[1] Includes chemical fuel reprocessing facilities.
[2] Costs of preparing uranyl sulfate are not significant.
[3] Includes cost of building originally constructed to accommodate HRE No. 1 as well as cost of alterations necessary for HRE No. 2.

FIVE-YEAR PROGRAM—Continued

Sodium graphite reactor (SRE), Santa Susanna, Calif.

Original estimate of initial low-power operations, June 1956.
Current estimate of initial low-power operations, June 1957.

Original estimated cost:	*Thousands*
Reactor fabrication	$3,500
Fuel fabrication	220
Building and supporting facilities	[1]
Total	3,720
Current estimated cost:	
Reactor fabrication	6,800
Fuel element fabrication	230
Buildings and supporting facilities	[1]
Total	[2] 7,030

[1] Cost of construction of buildings and supporting facilities financed by NAA was originally estimated at $0.5 million. The current estimate is $0.92 million. The building amortization is included in the overall cost of the project. The overall cost of the project through fiscal year 1957 including "Research and development" is estimated to be $19.1 million. Of this amount NAA will have shared $2.85 million of such overall cost.

[2] Does not include $1.1 million for power-generating equipment to be installed by Southern California Edison Co.

Experimental breeder reactor No. II (EBR II), Argonne National Laboratory

Original estimate of initial low-power operations, March 1958.
Current estimate of initial low-power operations, June 1959.

Original estimated cost:	*Millions*
Reactor fabrication	$12,000
Fuel fabrication	1,400
Processing plant	2,050
Total	15,450
Current estimated cost	[1] 29,100

[1] Based on estimate provided by AEC on Apr. 1, 1957, per letter as follows:

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington, D. C., April 1, 1957.

Mr. JAMES T. RAMEY.
Executive Director, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. RAMEY: Confirming our telephone conversation on Friday, March 29, 1957, regarding backup material furnished following the 202 hearings, the current estimated cost for the experimental breeder reactor No. 2 is $29.1 million.

As I explained to you, the cost of this project is under study and this figure is an estimation only which has not been approved by the Bureau of the Budget.

Sincerely yours,

RICHARD X. DONOVAN,
Congressional Liaison Officer.

Power Demonstration Reactor Program

FIRST ROUND

Consumers Public Power District (SGR), Beatrice, Nebr.

Original estimate of initial low-power operations, 1959.
Current estimate of initial low-power operations, 1962.

	Thousands
Original estimated cost:	
Reactor	$13,129
Fuel fabrication	631
Land, buildings, and supporting facilities	2,649
Electrical generating facilities	8,701
Total	25,110
Current estimated cost:	
Reactor	[1] 26,630
Fuel fabrication	631
Land, buildings, and supporting facilities	2,649
Electrical generating facilities	8,701
Total	[2] 38,611

[1] A contract with NAA for the construction of the reactor is being considered by the AEC. It provides for an incentive arrangement to complete the reactor within a target cost of $26.6 million and a cost ceiling of $39.1 million.
[2] Consumers investment in the total project cost amounts to $17.1 million, which includes electrical-generating facilities, initial fuel fabrication, land, buildings, and supporting facilities, and $5.2 million investment in the reactor plant.

Yankee Atomic Electric Co. (PWR), Rowe, Mass.

Original estimate of initial low-power operations, 1958.
Current estimate of initial low-power operation, 1960.

	Thousands
Original estimated cost:	
Reactor	$16,765
Fuel fabrication	([1])
Land, buildings, and supporting facilities	2,275
Electrical generating facilities	13,880
Total	32,920
Current estimated cost:	
Reactor	16,765
Fuel fabrication	2,000
Land, buildings, and supporting facilities	5,210
Electrical generating facilities	10,525
Total	[2] 34,500

[1] Not available.
[2] Cost of construction borne by Yankee Atomic Electric with no AEC investment in construction.

Power Reactor Development Co. (FBR) Monroe, Mich.

Original estimate of initial low power operations, 1960.
Current estimate of initial low power operations, 1960.

	Thousands
Original estimated cost:	
Nuclear facilities	[1] $34,300
Fuel element fabrication	[2] 3,500
Nonnuclear facilities	10,700
Total	48,500
Current estimated cost:	
Nuclear facilities	[3] 31,225
Fuel element fabrication	[3] 2,100
Nonnuclear facilities	14,000
Total	[4] 47,325

[1] Includes $5.2 million for temporary construction facilities, test, and startup costs, engineering interest, etc.
[2] Includes costs of core and blanket.
[3] Includes $7.7 million for temporary construction facilities, test, and startup, cost engineering, interest, etc.
[4] Costs borne by PRDC with no AEC investment in construction.

POWER DEMOFNSTRATION REACTOR PROGAM—Continued

SECOND ROUND

Wolverine Electric Cooperative (homogeneous reactor) Hershey, Mich.

Original estimate of initial low power operations, 1960.
Current estimate of initial low power operations, 1961.

Original estimated cost:	Thousands
Reactor	[1] $2,835
Fuel fabrication	([2])
Land, buildings, and supporting facilities	([3])
Electrical generating facilities	739
Total	3,574
Current estimated cost:	
Reactor	[1] 3,787
Fuel fabrication	([2])
Land, buildings, and supporting facilities	([3])
Electrical generating facilities	757
Total	[4] 4,544

[1] Includes chemical fuel reprocessing facilities.
[2] Fuel preparation costs for homogeneous reactors are not significant.
[3] Facilities to be located in existing structure.
[4] Wolverine Electric Cooperative investment in the total project cost amounts to $487,000 toward the nuclear portion of the plant and $757,000 toward the building modification auxiliaries, superheater, turbogenerator, etc.

Rural Cooperative Power Association (BWR) Elk River, Minn.

Original estimate of initial low power operations, 1959.
Current estimate of initial low power operations, 1961.

Original estimated cost:	Thousands
Reactor	$3,760
Fuel fabrication	---
Land, buildings, and supporting facilities	700
Total	[1] 6,185
Current estimated cost:	
Reactor	5,545
Fuel fabrication	---
Land, buildings, and supporting facilities	700
Electrical generating facilities	1,750
Total	[2] 7,995

[1] Approved as a basis for negotiation.
[2] Represents latest cost estimate. Revised proposal under consideration.

Chugach Electric Association (SGR) Anchorage, Alaska

Original estimate of initial low power operations, 1961.
Current estimate of initial low power operations.[1]

Original estimated cost:	Thousands
Reactor	$5,500
Fuel fabrication	([1])
Land, buildings and supporting facilities	---
Electrical generating facilities	[2] 1,850
Total	7,350
Current estimated cost [3]	

[1] Not available.
[2] Includes site and necessary structures.
[3] A revised estimate is not available. Contract negotiations are underway with Nuclear Development Corporation of America for the conduct of research and development for the sodium-cooled heavy-water moderated reactor concept.

POWER DEMONSTRATION REACTOR PROGRAM—Continued

SECOND ROUND—continued

City of Piqua (OMR) Piqua, Ohio

Original estimate of initial low power operations, 1961.
Current estimate of initial low power operations [1]

Original estimated cost:	*Thousands*
Reactor	$4,010
Fuel fabrication	([2])
Land, buildings, and supporting facilities	580
Electrical generating facilities	1,031
	5,621

Current estimated cost [1]

[1] A revised estimate is not available. The AEC has initiated work on the organic concept for preconstruction research and development specifically for the Piqua reactor, under an existing contract with NAA.
[2] Not available.

PRIVATELY FINANCED LICENSED PROGRAM

[In thousands of dollars]

Consolidated Edison Company of New York (PWR), Indian Point, N. Y.

Original estimated completion date, 1960.
Current estimated completion date, 1960
Original estimated construction cost, $55,000.
Current estimated construction cost, $70,000.[1]

Commonwealth Edison Co. (BWR), Dresden, Ill.

Original estimated completion date, 1960.
Current estimated completion date, 1960.
Original estimated contract price, $45,000.[2]

General Electric Co. (BWR) (boiling water reactor), Vallecitos, Calif.

Original estimated completion date, 1957.
Current estimated completion date, 1957.
Original estimated construction cost, $3,000 to $4,000.
Current estimated construction cost, $3,000 to $4,000.

[1] Reflects change in size from 236 to 275 EMW net.
[2] Relationship between contract price and cost of construction is not known.

(Previous correspondence from AEC regarding costs of the Shippingport project follows:)

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington, D. C., February 13, 1957.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. DURHAM: As you know, the estimated cost of construction of the pressurized water reactor (PWR) project, as of May 1954, was $37,750,000. This figure included the Duquesne Light Co.'s $5.0 million contribution, but was exclusive of the costs of the turbine-generator portion of the plant which are borne by Duquesne.

The estimate of $37,750,000 was made almost a year before construction began at Shippingport. The design of the plant was in a conceptual stage and the core design had not yet been established. Stene & Webster, the architect-engineer, had just commenced work, and an installation subcontractor had not yet been selected.

As of June 30, 1956, PWR construction costs plus commitments were approximately $25,400,000. Since the installation subcontractor as yet had no experience upon which to base his cost estimate for installation of the reactor plant, and since difficulty was being encountered in various areas of core and component fabrication, the construction cost estimate was placed under continuing review.

As more design information and manufacturing and construction experience became available, this review gave indication that the original estimate of $37,750,000 would be exceeded considerably. On January 9, 1957, we were advised by Westinghouse that their present estimate for construction costs of the PWR

amount to $55 million, including a contingency amount of $2,500,000 and excluding turbine generator costs.

The principal areas of increase are in core fabrication, in stainless steel component manufacture, in building and facilities construction, and in installation costs.

Since the original estimate was made, the size of the core has been increased approximately 20 percent. The large core has increased the number of control rod drive mechanisms and the number of fuel element assemblies required. More extensive core instrumentation to achieve the maximum design information from operation has been added. The cost of processing zirconium tubes and shapes has substantially exceeded early estimates.

The stainless steel PWR pump volute and valve castings are among the largest yet poured in the country. X-ray examination of these has disclosed numerous faults which has necessitated extensive reworking. Machining of the large stainless steel core structural supports and the reactor vessel head has been difficult and time-consuming.

Original estimates of buildings and facilities required as part of the reactor plant have proved low because of lack of information on design and layout at the time they were made. The final design of foundations, enclosures, and shielding required considerably more material and more difficult workmanship than originally anticipated. The early estimate of waste disposal system costs, made before a fuel element was selected and quantities and levels of activities to be discharged were established, has nearly doubled.

The revised plant installation costs are based on manpower and material requirements derived from information taken from final construction drawings and specifications.

We are presently conducting a detailed review of the estimates submitted by Westinghouse and we will advise you further as to the firmness of the present estimate when the results of this review have been received.

Sincerely yours,

K. E. FIELDS, *General Manager.*

The CHAIRMAN. We will go to No. IX, "Regulating and Licensing of the Atomic Energy Industry."

Mr. FIELDS. I would like the General Counsel to answer that question, sir.

Senator GORE. Mr. Chairman, might I ask one question before you come to IX?

The CHAIRMAN. Yes.

Senator GORE. General Fields, would you briefly state for the benefit of the committee, at least for my benefit, the nature of the cooperation which the Commission is receiving from Great Britain, on the part of Great Britain, in the matter of supplying to the Commission the technical information from their experience with the gas-cooled reactor at Calder Hall?

Mr. FIELDS. We have had numerous visitors that have inspected Calder Hall, sir. There have been discussions and exchanges in the general characteristics of, say, the Calder Hall reactor.

We have asked for specific information with respect to the Calder Hall reactor, that is, design details, specifications and so forth.

Senator GORE. Performance?

Mr. FIELDS. Performance; yes, sir. This is under consideration by the United Kingdom still. We understand that information is being compiled. I know the chairman has been in communication with the head of the Atomic Energy Authority and will be directing a letter to you in the next day or so, sir, on this subject.

(The letter referred to appears in the hearing of February 25, 1957, pt. 1, p. 348.)

Now, one of the problems is that there is some confusion as between the Calder Hall reactor itself and the other reactors that would be

built under the Electrical Authority. We have had discussions between us as the exchange of information on that reactor, sir.

Senator GORE. I would like to have, if it is available, some more specific information.

You say you have information that the data is being compiled. Do you have information that a decision has been made on the part of the United Kingdom to supply such information?

Mr. FIELDS. I do not at the moment. We directed a request to them in January, as I recall, for the specific information that I am talking about.

Senator GORE. Are not provisions made for reciprocal exchange of information, technical information, in the bilateral agreements?

Mr. FIELDS. Yes, sir; that is correct.

Senator GORE. Now, in case the Commission eventually succeeds in obtaining the desired information, will it be made available to private industry in this country without strings?

Mr. FIELDS. This is the problem that is under discussion at the moment, sir. It depends on the origin of this information as the bilateral spells out.

Senator GORE. Origin?

Mr. FIELDS. Yes, sir, whether it originates in the Government atomic energy program in England, or whether it originates in their industry in England. That is the question of origin.

Senator GORE. What do they consider industry?

Their Electrical Authority is a Government-owned corporation, is it not?

Mr. FIELDS. I believe that is true; yes, sir.

Senator GORE. I seem to detect some reluctance on your part to discuss——

Mr. FIELDS. My only reluctance is that we have this under discussion with them, that we anticipate writing you in some detail about this very shortly when we have this resolved, sir.

Senator GORE. But as of now you are not yet assured that you will receive the information?

Mr. FIELDS. I am not yet assured that we will receive this information is such a manner that it can be used throughout our access permit program, although it might be classified. This is the question that is under consideration. It arises from the terms of the bilateral itself, sir.

Senator GORE. Will not be available for use throughout your access——

Mr. FIELDS. Access permit program. It might be available to our Government and any construction we build ourselves.

Senator GORE. In other words, it might be reciprocal viz a viz government-to-government?

Mr. FIELDS. Yes, and industry-to-industry. In the latter case it would probably be on a licensee base, but this is the discussion that is going on at the present time.

Senator GORE. You are not assured, if I understand you, that even though the desired information is made available to the United States, it will be made available in such manner and under such terms and conditions that you, in turn, can make it available to private enterprise in this country, but that instead, it might be reserved for the use of the Government, itself?

Mr. FIELDS. This is what is under discussion, sir. I am not sure it will come out that way.

Senator GORE. You started to make a comment.

Mr. FIELDS. I started to make the comment that the bilateral under certain conditions provides for exchange of detailed information, designs, and specifications. The conditions are an understanding that when you ask for this information you are seriously considering the construction of that type of reactor, if you follow me.

Senator GORE. Now, by "seriously considering," do you means that the Government itself must be "seriously considering," or some concern within the United States must be "seriously considering?"

Mr. FIELDS. I would have to examine that one. I would have to look at the bilateral further on that.

Senator GORE. Mr. Chairman, I will not pursue this matter further because it is one which, when finally negotiated, the committee will wish to go into.

Mr. FIELDS. I am sure that as soon as we resolve this we will be communicating with the Joint Committee at once, sir.

(The letter referred to appears in the hearing on February 25, 1957, pt. 1, p. 348.)

The CHAIRMAN. You had that request to make at the beginning of the hearings, and I believe it was the agreement reached that it would be made available to the committee, as soon as it is received.

Now, we will go to No. 9, regulation and licensing.

Mr. FIELDS. I will ask Mr. Mitchell, the General Counsel, to answer that, sir.

Mr. RAMEY. In planning for the inspection and cooperation with State agencies with respect to reactor safety activities, has the commission taken the position that health and safety regulation is preempted by the Federal Government by reason of the Atomic Energy Act of 1954 or is it taking the position that health and safety regulation resides in the States, or possibly is there concurrent jurisdiction?

Mr. MITCHELL. Mr. Chairman, we have not taken any position as to whether or not the Atomic Energy Act of 1954 preempted the field. We have tried to work closely in cooperation with the States.

As we have already advised your committee, we have under consideration the possibility of suggesting a clarifying amendment to the Atomic Energy Act of 1954 which would expressly permit the States to adopt health and safety standards with respect to atomic energy which would be consistent with the Commission's regulations.

The CHAIRMAN. Will this be dependent on the States passing some type of enabling legislation? Would it make it necessary?

Mr. MITCHELL. This, I think, would have to be answered State by State. I don't know what would be necessary in each State, whether a new statute would be necessary, whether there is sufficient authority by way of regulation in existing health authorities, for instance, or governmental agencies of this kind.

Our concern would be, if we should propose such an amendment, to make it clear that the States have an area in which they may act if they choose to do so.

The CHAIRMAN. Of course, most of the legislative bodies are meeting this year, now. Have you given any thought to having a conference with the attorneys general of each State to try to formulate some policy at both National and State levels?

Mr. MITCHELL. Mr. Chairman, I think I would prefer to have Mr. Price answer that question. He has been dealing with most of the States in this area.

Mr. PRICE. Mr. Chairman, we have talked to representatives of various departments of a number of the States. In addition, beginning last summer at the governors' conference, we have been working with the Council of State Governments, and the executive director of the governors' conference, on State legislation. The Council of State Governments recommended a so-called model law to all of the States based on the New England plan which about eight States have already adopted.

The Commission has endorsed that approach by the States. The Council of State Governments has been notified of this endorsement and in turn, the executive committee of the governors' conference which met, I believe, last week, had the matter under advisement.

We are now, and have for the past few weeks, been getting inquiries from various States and our position is that if they are ready to legislate we support this so-called model law.

We think there are numerous areas that the States will be interested in that are beyond the problems that we deal with.

For example, they will have to think about their workmen's compensation laws. They will have zoning problems. They will have the problems of their public utility rate fixing boards and also the problem of radiation sources, such as radium and X-ray machines which do not fall in the jurisdiction.

In addition, in this field of health and safety, our suggestion to them has been that, to the extent that they adopt radiation standards, they try to make them consistent with ours so that we will have a uniform, harmonious system; and in this area it would be concurrent regulation, because the Commission does not at the present propose to relinquish regulatory control to the States.

We do not think that at this moment the States could pick it up. But there is certainly room for Federal and State cooperation, both regulating in this area, at the present time, and that is what Mr. Mitchell had reference to in terms of Federal legislation that would clarify the role of the States in this area—make it clear that they do have this jurisdiction.

The CHAIRMAN. Since it is of such prime importance and concern to all the people and the States, I certainly hope that the Commission will exert all efforts possible to try to get some coordination in the way of measures that will be of benefit to the atomic energy program.

Mr. PRICE. Yes, sir; and we have probably mentioned before, we have had an advisory committee of State officials, representatives of State health departments, labor department, and attorney general's offices, that have worked with us in the development of the regulation on radiation standards which was published in January of this year, and actually in the development of that regulation which covers the area that the States are interested in we solicited the views, of all the 48 States and the interested agencies in the 48 States.

So we have thought this was terribly important and we have done everything we thought was possible to be sure that we got the support of the States in this area.

The CHAIRMAN. I received a copy of a letter this morning which went to Mr. Frank Bane, executive director of the Council of State Governments from General Fields. Without objection I will insert this letter in the record because it carries a lot of information on publicity.

(The letter referred to follows:)

MARCH 2, 1957.

Mr. JAMES T. RAMEY,
Executive Director,
Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. RAMEY: In accordance with the conversation that Mr. Harold Price had with you, I am forwarding you a copy of a letter to Mr. Frank Bane, executive director, the Council of State Governments.

We hope to be in a position to make firm recommendations on the legislation presently under consideration and referred to in the letter to Mr. Bane within a few weeks.

Sincerely yours,

R. W. COOK, *Deputy General Manager.*

FEBRUARY 20, 1957.

Mr. FRANK BANE,
Executive Director, the Council of State Governments,
Chandler, Ariz.

DEAR MR. BANE: In light of the suggested State legislation in the atomic-energy field, published in the Council of State Governments' Suggested State Legislation Program for 1957, I am writing this letter to confirm the views expressed by members of the Commission's staff regarding this suggested legislation.

As you are aware, the Commission has made efforts to solicit the views of the States in connection with the adoption of its standards for protection against radiation regulation, has sought State participation in inspection of licensees of the Commission, and has attempted to keep the States apprised of activities within their borders that are licensed by the Commission.

The legislation which the council has included in its 1957 program appears to the Commission to be consistent with the cooperative approach which the Commission has endeavored to undertake. The enactment of legislation modeled after the Coordination of Atomic Development Act would be useful from the Commission's standpoint for several reasons.

First, it would direct the attention of applicable State officials to the growing problems of the atomic age and would call for continuing studies of State legislation and regulation affecting the atomic-energy industry with a view both to encouraging the healthy development of that industry and to protecting the public interest. We believe that such a continuing review of State laws and regulations is desirable.

Second, it would establish a Coordinator of Atomic Development Activities to coordinate State activities intended to promote the development of atomic energy and to serve as a point of contact for cooperation and collaboration with the Federal Government in this field. We believe the establishment of such a single point of contact could assist the Commission's program of collaboration with the States and would be in the interest of assuring that the interests of all State agencies are recognized.

Third, it would authorize the heads of appropriate State agencies to cooperate with the Federal Government in the administration of the act or matters pertaining thereto. As we understand it, this provision would authorize the cooperative arrangements with the Atomic Energy Commission for inspection of federally licensed activities to which we have referred above.

Fourth, it would establish machinery for development and review by the States of regulatory measures applicable to forms of radiation not regulated under the Atomic Energy Act.

Fifth, it would prohibit under State law, and authorize injunction of, activities within the State for which a Federal license is required and has not been obtained. This provision would furnish an additional means of enforcing the Federal licensing requirements. It has been carefully drafted to avoid the

imposition of undue additional burdens on Federal licensees or the possibility of conflicting interpretation of the necessity for a Federal license.

It is the opinion of the Commission that, to permit maximum development in the atomic-energy field, it is essential that regulatory action applicable to this new industry be as uniform as possible in order to avoid overlapping or conflicting controls. The Coordination of Atomic Development Act recognizes this important consideration and declares it to be State policy to exercise regulatory authority, to the extent that the State may have such authority, so as to conform to the Atomic Energy Act and regulations thereunder, thereby permitting a single harmonious system of regulation.

We believe that the growing importance of atomic-energy activities in many of the States may make it appropriate that such States take legislative action in the field of atomic energy. We believe it is equally important, however, in an area presently covered by comprehensive Federal regulation, that the States not take action which could be productive of conflict and confusion. The problems of atomic energy are new and constantly changing. We believe they can best be dealt with by a collaborative approach of Federal, State, and local officials which will give full assurance that the health, safety, and welfare of the public is adequately protected. The progress of the Federal Government which we have described above, together with the enactment by the interested States of legislation along the lines of that suggested by the drafting committee of the Council of State Governments affords a means, we believe, of promoting such a collaborative approach. We recognize that the draft bill suggested by the committee may need adaptations to take care of the particular requirements of each State. We would be glad to work with interested State officials in this matter, looking toward the development of an integrated Federal-State program.

We presently are considering an amendment to the Atomic Energy Act of 1954 which will have two basic objectives. The first is to clarify the Commission's authority to enter into agreements with the States to utilize the services of the States in connection with the Commission's responsibilities for inspecting the activities of persons licensed by the Commission and to assit in training employees of appropriate State agencies.

The second objective of the amendment would be to clarify the respective roles of the States and the Commission in protecting the public from radiation hazards attendant to the processing and utilization of source, byproduct, and special nuclear material. We understand that four States have already adopted comprehensive radiation regulations and that several others are considering the adoption of such regulations. In recognition of the responsibilities of the States to their local population in regard to health and safety matters, the legislation under consideration recognizes the interests of the States in assuming enforce radiation standards in the field regulated by the AEC. The Federal legislation under consideration recognizes the interests of the States in assuming their local responsibilities while at the same time attempts to prevent the atomic-energy industry from being subject to unnecessary regulatory burdens. Such legislation would exempt Government facilities and activities from State regulation. To avoid any of the undesirable consequences that could flow from both the Federal Government and the State governments regulating the same aspect of the same subject matter, there are two additional limitations in the proposed legislation. The radiation standards adopted by the States should be consistent with those adopted by the Commission. The Commission has a responsibility, as you know, both to protect the public from radiation hazards and to impose minimum regulations in order to avoid any undue burden on the atomic-energy industry. It would be inconsistent with the exercise of this responsibility if the States were able to relieve persons for compliance with the Commission's standards or to impose additional burdens on persons subject to the Commission's standards. The second limitation is that the authorization to the States to adopt radiation standards would not include authority to exercise licensing responsibilities. There appears to be no good reason for unnecessarily burdening persons subject to AEC licensing requirements to dual licensing proceedings with regard to the same aspect of their activities.

In addition to the legislation under consideration, the Commission plans to make a study of the need for additional authority to negotiate with the States agreements which may include provisions delineating the separate responsibilities of the Commission and of the States with respect to the regulation, including licensing and inspection, of the health and safety aspects of atomic energy. The Commission feels it is important at this time to attempt to evaluate the extent to which it may be desirable for the Commission to turn over certain of its

present regulatory responsibilities to the States. As you are aware, there is the question whether certain aspects of radiation protection are of such a nature that they require centralized regulation by a single agency.

The Federal legislation discussed above has not yet received clearance within the executive branch. However, we will attempt to obtain expeditious consideration of this legislation. We will be in further contact with you on this matter.

Sincerely yours,

K. E. FIELDS, *General Manager.*

Representative HOLIFIELD. I think we are touching on an important thing here, a very important point. The Federal Government, by virtue of both acts, asserted ownership to this material and the products made from this material that have this lethal radioactivity quality.

Now, I say it is not enough to put this on a permissive basis for the States, because some States may or may not have the knowledge or the facilities to carry out properly the protection of the users and the environmental personnel that may be around this element.

You spoke of the model law. Did the Commission originate that model law?

Mr. PRICE. No, sir; it was originated by the New England Committee on Atomic Energy to the New England Governors Conference in 1954 or 1955. It is a statute that, insofar as it relates to regulation, is aimed at being sure that any regulatory controls that the States adopt will be consistent with the regulation of the Commission.

Now, we do not propose, Mr. Holifield, to drop any of the controls that we have. The Atomic Energy Act gives the Commission complete authority in this field and, to the extent that the health and safety problems can be dealt with by regulation, we have entered the field completely.

What we are talking about is a program under which, in the field of radiation standards and inspection, we could enlist the help of the States.

Take, for example, the four thousand or five-thousand-odd isotope users. Many of the States are—in fact, they are already being—helpful to us in the inspection program.

So we are not talking about turning over to the States any authority that Congress has imposed on us. We are talking about getting the States in a position to work in parallel, so to speak, in cooperation with us.

Representative HOLIFIELD. I did not assume you were turning over formally to the States your responsibilities, but you might fail to discharge your responsibility by default, by allowing States which have not complied, or have not passed model laws or enabling acts, or did not have proper inspection personnel allotted to do this job. You might by default lose control of the health hazard facet of this material if you did not have a vigorous responsibility on the part of the Federal agency to see that these materials did not go into States which had not complied with the proper type of State legislation.

Mr. PRICE. Sir, on that point this is our No. 1 responsibility, this health and safety problem in dealing with hazards. We would let the material go into the State whether they had a law or not, but we would rely on our own regulations rather than any State regulations in that case.

Representative HOLIFIELD. All right, but would you follow with Federal inspectors to see that it was used, in States which did not provide inspection, up to your standards?

Mr. PRICE. Yes, sir; our inspection program would contemplate that we would only use State inspectors to the extent that we would work out an agreement with the States to have qualified people which we would work with and in the States which had not adopted any inspection program and did not have people to do this work, we would do it directly. This is just a matter of supplementing our own forces in those States that have a contribution to make.

Representative HOLIFIELD. I am not opposed, of course, to the utilization of State facilities where those facilities exist. The point I want to make is this:

I think it would be a grave mistake for the Federal Government to in any way lose track of this material and the uses of this material and the manners in which it is used because of the general lack of knowledge, particularly in these industrial fields.

I know there are over 1,100 users right now in the industrial field. How much of a followthrough is made to protect the industrial users and the people around them from misuse of materials of this kind?

Mr. PRICE. I think for the past few years there has been an average of about 400 visits to licensees' plants. It is not just a spotcheck and it is not a hundred percent check of all users.

The CHAIRMAN. It does not cover all outside users: is that correct?

Mr. PRICE. It covers them, but the question is how often do you get around to inspecting a particular company?

Representative HOLIFIELD. This indicates to me that you do not have a firm control of uses of this material. Now, I understand it is a big job; it is a tremendous job, and as this widespread use of these materials continues to expand I can understand where it can become a tremendous burden.

The inspection and the accountability of location, the manner in which this radioactive material is used, I can foresee a tremendous job there and a tremendous responsibility, but at this time I cannot see how the Federal Government can fail to take a very serious look at this whole program.

Now, we had the reproduction of a story that was handed to this committee by one of the witnesses last week where a man, and I assume this is a genuine case, where a man was using one of these capsules for detecting flaws in steel and it was so carelessly guarded that this man had access to it without knowing what it was; he picked it up and put it in his pocket. Later on he transferred it to the automobile.

Now, there has been no one deny that this happened, has there?

Mr. PRICE. No, sir. I might mention that the company that was using that material under license, just as a matter of record, has been inspected three times since 1952, I believe.

Now, in that particular case, there were 3 men in charge of that source, 1 on the upper level and 2 on the lower level and the man at the upper level walked away and before a man from the lower level got up there this man came in and pulled the string loose.

That is what happened.

Representative PATTERSON. What has been the result of inspection?

Mr. PRICE. I don't know how inspection would have cured the human error if that is the proper way to characterize it. The fact

is that there were three people in charge of that job. The place was posted with radiation caution signs. The source was on the end of a string, tied at an upper level and the source was dropped down to check some welds on some piping. Both the upper level and lower level I believe were posted.

There were two men guarding the lower level where the source was hanging. There was one man at the upper level at the end of the string. He left the place and I believe yelled to the people downstairs for one of them to come up. While the other man was going upstairs, and before he got there the man that found the source came in looking for a piece of string and pulled it.

Senator GORE. He got slightly more than a string.

Mr. PRICE. Apparently from the report, he thought it was some kind of oil cylinder or something.

(An AEC report on the Zawacki incident requested by the Joint Committee follows:)

REPORT ON ZAWACKI INCIDENT

The incident occurred on January 10, 1956, near Milford, Conn. Radiographic inspection of welded piping was being performed by Sam Tour & Co., 44 Trinity Place, New York. Sam Tour & Co., possessed a cobalt source under authorization from the AEC. The authorization had been issued under the isotopes distribution program begun by the AEC under the 1946 act.

In accordance with the then-existing authorization procedures, Sam Tour & Co., had been required to specify the safety measures it would take to protect individuals against overexposure to radiation. These measures included providing instruction in safe use of radioisotopes to the company's personnel, and posting of radiation warning signs in areas where work with radioisotopes would be carried on. Various improvements in the company's safe operating procedures were made from time to time in accordance with recommendations of the Isotopes Division following visits to the company to evaluate its safety program. Among other things, the company followed the practice of keeping areas where radioisotopes were in use under surveillance of its personnel.

This incident illustrates, however, that as in every large industry occasional accidents will occur regardless of the emphasis on safety. In this case Sam Tour & Co., was conducting radiographic operations with cobalt 60 at a power-plant construction project. The cobalt 60 source was suspended on a string between two floors of the partially completed building for the purpose of radiographing a steam pipe weld. The work area was posted with radiation-warning signs and 3 persons were keeping the work area under surveillance, 2 on the lower floor above which the source was suspended and 1 on the upper floor where the string to which it was attached was tied. The man on the upper floor left his position and Mr. Zawacki took the radioactive source during the interval before another watcher could arrive from the lower floor to replace him. The AEC learned of the incident on January 12, 1956, 2 days after it occurred, and the Division of Inspection initiated an investigation.

On February 17, 1956, the Isotopes Extension, Division of Civilian Application, directed a letter to Sam Tour & Co., which recommended certain improvements in operating procedure. Following exchanges of correspondence between the Isotopes Extension and Sam Tour & Co., a letter of May 3, 1956, to Sam Tour & Co. confirmed that revised procedures outlined by Sam Tour & Co. appeared satisfactory. The company was visited by the Isotopes Extensior in December 1956 and its operations found to be satisfactory.

Responsibility for inspection of Sam Tour & Co. activities has been assigned to the New York office in accordance with policy and procedures established by the Division of Inspection. Initial contact between the Inspection Division of the New York office and Sam Tour & Co. has been established, initial inspection has been scheduled, and periodic inspections of field activities will be made in conformance with our program requirements. In this connection, the Commission has made nearly 2,000 visits to users of radioisotopes during the past 10 years to evaluate their safety programs. In recent years these visits have been made at the rate of about 400 a year.

Safety procedure such as were employed in the present case had been proven by experience to be suitable since there had been no reportd incident of this kind in the preceding 10 years of the radioisotope distribution program. Nevertheless, the Commission developed and published in July 1955 as a notice of proposed rulemaking 10 CFR 20, Standards for Protection Against Radiation. In accordance with the Atomic Energy Act of 1954, the Commission also revised 10 CFR 30, Licensing of Byproduct Material, by which the authorization procedure was modified into a licensing system. The revised 10 CFR 30 became effective on February 10, 1956, and thereafter the proposed Standards for Protection Against Radiation was included as a condition of each license issued. Where necessary, applicants are further required to establish formal administrative procedures for assuring that adequate radiation protection standards are observed within their organization. These administrative procedures also are incorporated in their license. In addtion, the Commission proceeded to contact all persons who had received radioisotopes prior to February 10, 1956, for the purpose of converting their authorizations into licenses, thereby subjecting them to the radiation protection standards and the requirement to have administrative procedures. Although some authorization holders have not been contacted as yet, the Standards for Protection Against Radiation became an effective regulation on February 28, 1957, and thus is legally applicable to all persons who possess radioisotopes, whether under the old authorization procedures or the new licensing system.

Barring unforeseeable human error, observance of the radiation protection standards and administrative procedures by licensees provides reasonable protection against incidents such as the one in question. It is equally true, however, that as additional experience is gained in any activity, the need for further refinements in safety procedures becomes apparent. For example, if a warning tag had been attached directly to the radioactive source, the likelihood of this incident occurring might have been materially reduced. The Commission's licensing procedures now in fact include such a requirement.

Representative HOLIFIELD. I don't know what the answer is and I do not know whether there is going to be a method which can be worked out to protect users and people in the environment from these materials, but I think it is a very serious problem and I think we would make a great mistake if we attempted to delegate this to the States, with their present grasp of the deadliness of these materials.

In the last analysis, the Atomic Energy Commission is going to be held responsible if a catastrophe occurs, if a group of people are exposed to this material and great harm is done.

Mr. PRICE. Mr. Holifield, I am sure the Commission intends to have as vigorous an inspection program as the situation requires.

Now, how many visits and how often that means you visit, I don't thing I am prepared to answer.

As a matter of fact, as you know, inspection is set up under the law as a separate division.

Mr. FIELDS. Mr. Holifield, we recognize the seriousness of this problem and I think our views parallel quite considerably your views as you have expressed them. We are insuring, for instance, that any reactor at this time that is built, when you get to reactors, has a startup inspection and all the detailed procedures are inspected by Federal employees before they start.

We are following this very carefully. In the field of isotopes, with the widespread use, the best we can do is to insure that their practices are correct, as we did in this case, sir.

I think that the record will show that this company had a clearance on its inspection for the use of this isotope. Somebody fell down.

The CHAIRMAN. I asked the Commission, I believe, a few days ago, for a full explanation of the cost, the number of inspectors and the full program that you are carrying out at the present time.

Mr. PRICE. We will supply that for the record.

(See AEC letter, dated March 20, 1957, pt. 1, p. 320.)

Representative HOLIFIELD. This brings up the question of the whole problem of the field of responsibility that will be on the Commission in the field of licensing, inspection, and regulating for industrial purposes.

I am just wondering how much of the time of the Commission is going to be taken in this field and how much diversion you are going to have from your primary role or mission which in my opinion is the production of this material and the development of weapons and the research and development, and of course for peaceful application.

As this art expands there is going to be need, it seems to me, for a tremendous number of people to discharge this expanding responsibility in the fields of industrial use.

Mr. FIELDS. There will be a requirement for expansion; yes, sir.

I believe we wrote the Joint Committee on this subject a month or so ago, at some length, stating the Commission's views in that respect.

Mr. PRICE. In these cases, Mr. Holifield, to round out the record, I ought to say that every one of these isotope users, before he gets a license gets a thorough evaluation, a prelicensing evaluation of his competence, of his procedures that he is going to use in handling the material, a determination that his equipment is adequate and then, of course, the regulations themselves impose stringent rules about exposure of personnel and control of radiation sources. Over the years as far as istotopes are concerned, I think it will have to be said that the record is good.

The isotopes have been distributed for about 10 years and there have been very, very few instances of the kind that we are talking about.

The CHAIRMAN. We will take up raw material next.

We deferred that because Mr. Dempsey had some questions. That is No. III.

Mr. RAMEY. The testimony indicates that the uranium supply is no longer a limiting factor in either the civilian or atomic weapons program.

Does that mean that we have a surplus of ore or that we can foresee a surplus?

Mr. FIELDS. Mr. Chairman, I would like Mr. Johnson, the Director of Raw Materials Division, to answer the question.

The CHAIRMAN. Mr. Johnson.

Mr. JOHNSON. Mr. Chairman, in the interest of brevity and I hope clarity, I wonder if I might read the answers I have prepared and then expand as the committee might wish.

The CHAIRMAN. You may proceed.

Mr. JOHNSON. The Commission's contractual arrangements including the publicly announced domestic procurement program should enable it to limit its purchase of uranium to its established procurement goal.

Consequently, we do not anticipate a surplus. However, the Commission is in a position to expand substantially its uranium procurement if requirements are increased, or if a stockpiling program is undertaken.

Therefore, we should not be faced with a uranium shortage for our military or power programs as now established during the next 10 years.

We are studying the advisability of a uranium concentrate stockpiling program. We would not favor stockpiling ore for longer periods. Domestic ore production and milling operations in any area should be in balance and to the extent practical and economic we would like to see these operations planned for a period not less than that of the extended domestic procurement program.

We anticipate current ore stockpiles will be reduced within the next 2 or 3 years to normal mill inventories.

Present plans call for operating our facilities for the production of fissionable material at the highest practical feed rate through 1966.

If necessary, fissionable material production could be slightly increased by feeding more uranium concentrate, but this would not be an economic procedure.

The question of stockpiling fissionable material involves a consideration of our weapons program and we suggest that a discussion of this matter be reserved for executive session.

I might say by way of explanation that the last question on fissionable material production is out of my field and this answer was prepared in collaboration with the management in charge of fissionable material.

The other answers I have responsibility for.

The CHAIRMAN. Where does that place the small producing mines, Mr. Johnson, since I understood from your statement that you do not believe it would be wise to stockpile the ore. What kind of position would that put them in?

Mr. JOHNSON. We anticipate that there will be adequate mill facilities to take care of scheduled ore production. That has been the aim throughout the program because, as you know, it has been our objective to get the material that is in the ore into fissionable material as rapidly as possible.

The only reason for building up stockpiles in the past has been because of the time lag during the construction of a mill.

First, I might say this, that before facilities for ore buying or milling can be installed it is first necessary to discover the ore and then carry out development to determine whether the available ore justifies either of these facilities. Consequently, there always has been some lag between the availability of a local market for ore and the ability of the miners to produce.

The CHAIRMAN. How many processing plants do you have at the present time?

Mr. JOHNSON. We have 12 mills in operation and the number will be increased, as far as we can see now, to something like 24, or possibly more.

The CHAIRMAN. How many of those are Government owned and how many privately owned?

Mr. JOHNSON. There is only one Government-owned plant and that is at Monticello, Utah, a plant built by the Government during the war period for the production of vanadium.

The CHAIRMAN. At what date do you think you will be able to take all the uranium that is being produced?

Mr. JOHNSON. At the present time, there are only two areas in the West that are producing ore that have not adequate facilities for

handling all of the ore being produced. These are the Cameron, Ariz. area, and the Gas Hills Crooks area in Wyoming.

The CHAIRMAN. That is two out of how many producers?

Mr. JOHNSON. I would say roughly 5 or 6 distinct processing areas. I would have to review that. But some of these areas, like the Uravan area in Colorado, Grand Junction, extend over quite a territory and there are a number of mills in that particular area.

But in the instance of Wyoming field, for example, the first discovery was made in about 1953. It was not until 1954 that there was evidence of much production and we established a buying station at Riverton, Wyo., without knowledge as to whether there would be enough ore for a mill, or not.

During 1955 development progressed rapidly and in 1956 it became evident that 1 or 2 mills would be built. We have since made 2 contracts for 2 milling operations, 1 for 400 tons a day, and 1 for 750.

One of the mills will be completed in June or July of this year, the other one probably by the end of the year or early next year.

Now, our ore buying station at Riverton is about 40 miles from the major sources of ore. We established it there because it was on a railroad. If enough ore was not developed in the area for a mill, we could ship the ore at reasonable freight rate to another mill.

When it became evident that two mills were going into the area and production was increasing, we did not expand our ore-buying facilities at Riverton. We endeavored to furnish a limited market to all the producers and keep production down until facilities could be established at the mill sites and thus avoid the haulage of ore.

We have just started to buy ore at the site of one of the mills on a provisional basis. The sampling facilities are not yet completed. We are doing this to assist the producers in the area.

When the mill starts the mill operator will then take over the ore buying responsibilities.

In the Cameron area the problem has been twofold. One, the mill which went into operation during 1956 had some metallurgical problems; it did not operate at full capacity.

Another problem that is inherent in the Cameron area as well as in the Crooks Gap area is that the deposits in these areas are shallow; they are mined by open-pit methods, the surface, sand, and rock is stripped by bulldozers and scrapers.

When the ore is exposed, it is merely a matter of loading it into trucks and it is possible for a small deposit, say 5,000 tons, to be able to be mined at a daily rate of equivalent to a large underground mine in another area.

As a matter of fact, many of the miners do not even carry on stripping or mining operations, but contract it all. So that it will not be possible, it is not practical to permit every mine as soon as it is opened up to load the ore on the trucks as fast as possible and for a month or two and to pour the ore into a buying station or mill.

The CHAIRMAN. What is the chief objection to stockpiling the ore?

Mr. JOHNSON. Stockpiled ore in the open is subject to erosion and wind losses. It cannot be used except after milling. It must eventually be milled near the stock pile site and it would be far better immediately to produce a semifinished product so that it would be available

for any refinery where it might be needed. It would not be necessary to maintain milling facilities in the stockpile areas indefinitely.

It would be, and I believe it has been, the practice of the national stockpiling program to only buy materials in a finished or semi-finished form unless chrome ore or manganese ore that moves into the furnaces in the crude state.

The CHAIRMAN. That requires a whole lot less storage space after you reduce it to usable material?

Mr. JOHNSON. That is correct.

Mr. VAN ZANDT. What about the concentrate? Does storage have any effect on it?

Mr. JOHNSON. No; the concentrate is in a form that is reasonably compact. It can be stored without difficulty. It is then in a condition to be converted either into the metal or salts, or any of the materials required in the atomic energy program.

Mr. VAN ZANDT. No deterioration at all?

Mr. JOHNSON. No deterioration; no, sir.

The CHAIRMAN. Did you give us the date as to when we can expect the processing plant to take all of the ore?

Mr. JOHNSON. I want to qualify that by the statement I just made, that I believe that the ore production in the area should be scheduled according to the mill capacity. For instance, let me give you an example:

Suppose in an individual area 350,000 tons of ore are discovered. That is all the ore found. It is a shallow deposit.

Now, the most economical mill operation, certainly the largest size, would be about 200 tons a day. The mill would have a 5-year operation. It obviously would be uneconomic to put in a thousand-ton mill for a 1-year operation and then close it down. No private commercial business would operate that way.

The CHAIRMAN. That kind of policy, though, does limit the mine on its production of ore, does it not?

Mr. JOHNSON. But the miners themeselves would limit their production if they were a partner in the milling operation.

If a small miner had found this 350,000 tons of ore, financed a mill, he would not consider a thousand-ton mill. He would consider a mill of the size I mentioned, about a 200-ton mill and then he would mine his ore in relation to the mill requirements with only a normal mill inventory.

A stockpile of ore that is sitting on the ground, as I said, is subject to wind losses, erosion losses, and it ties up a large amount of capital.

A 350,000-ton ore stockpile would represent something on the order of $6 million. It is safe in the ground; it can be left in the ground until fed into the mill.

Now, we do have problems and we try to work them out. Where a small miner has a very limited quantity of ore, you can't spread, say, a thousand tons over 5 years. You have to let him get it out in a matter of a few months. We have to meet those problems as best we can by handling the individual hardship cases as they arise.

The CHAIRMAN. This has been one of the brighter spots of this whole program. I hesitate to question your judgement on the matter of securing ore to carry out the program. I do think it is important that we keep these mines in operation and extend the buying of this program, I think we have.

There has been some complaint, as you know, that we are not taking all the ore.

Mr. JOHNSON. I made a talk in Denver on the 9th of February last in which I outlined some of our problems and the need for a long-range solution. I anticipated that there might be some critical remarks on the part of the miners or the press, but up to the present time at least there have been very few and I have talked to the small miners as well as the large miners.

In view of the fact that Mr. Weller, in his testimony, which I think was very good, did refer to my Denver remarks, you might want to consider having this talk placed in the record.

The CHAIRMAN. Without objection, that will be placed in the record.

(The information referred to follows:)

REMARKS PREPARED BY JESSE C. JOHNSON, DIRECTOR, DIVISION OF RAW MATERIALS, UNITED STATES ATOMIC ENERGY COMMISSION, FOR PRESENTATION AT THE NATIONAL WESTERN MINING CONFERENCE, DENVER, COLO., FEBRUARY 9, 1957

THE DOMESTIC URANIUM PROGRAM AS IT LOOKS TODAY

We now have reached the position where the uranium supply from existing contracts and from estimated increased domestic production will provide for the Commission's requirements as now established. We no longer are concerned over the possibility of a uranium shortage for the Government's military and power development programs as projected for the next 10 years.

Government requirements, of course, may change. They have been subject to many revisions during the last 9 years—always up. However, it is my opinion that the uranium industry should now study the potential commercial market and look to that market for its main support after 1966. Atomic power for industrial use may become an important market factor much sooner than generally expected.

American manufacturing companies already are prepared to contract for the construction of atomic powerplants designed to be competitive in high-cost power areas. At least one American mining company has received and seriously considered a detailed proposal for a fairly large atomic powerplant for one of its foreign operations. The estimate was reasonably competitive with that for a conventional powerplant considering the fact that the atomic plant would be built at the mine, thus saving transmission costs. However, lack of experience in the operation of a commercial atomic reactor is a serious handicap, especially for an industrial operation with only one source of power.

Once atomic power has been demonstrated to be practical and economic in a commercial operation, this new industry should be headed for rapid growth. Because of the characteristics of atomic energy, I have the impression that the plans for the commercial application of atomic energy, and estimates of operating performance, generally have been conservative, which they should be. For example, all AEC production reactors have given vastly better operating results and better economy than estimated at the time they were designed. The *Nautilus* has had more than 50,000 miles of cruising duty and the fuel elements have not yet been replaced. Originally, 10,000 miles were estimated as being a satisfactory minimum. Other reactors have also operated at power levels much higher than design specifications. If the performance of industrial power reactors follows this pattern, we may not be far from competitive atomic power.

I recall that only 9 years ago an atomic-powered submarine was only a dream. Many of the experts were skeptical about the success of the project. You have heard the story of the *Nautilus*. In my opinion the progress made during the past 2 or 3 years in the development of atomic power for industrial use has been equally remarkable. I am judging not by technical advances, for that is not my field, but by the large expenditures being made by governments and private industry for test plants, prototype plants and production plants; and by the fact that most of Europe is planning large atomic power programs on the basis of power costs that can be achieved with present technology. European countries already are considering substantial commitments for uranium.

The United States is fortunate in having cheap power from conventional fuels. We must improve reactor technology in order to make atomic power competitive in our large power consuming areas. Last night Dr. Libby indicated that improved technology might increase fuel efficiency and reduce the quantity of uranium consumed per unit of power production. This need not worry the uranium producers because the principal market for uranium will be the fuel elements and inventory stocks for new reactors. The more efficient the reactors, the more reactors, and the more reactors the greater the uranium market.

Several years ago, someone in the Commission, speaking of atomic energy developments, said that the optimists of yesterday look like pessimists today. As yet, that statement has not been disproved.

As we enter the era of atomic power, the American uranium industry is in a strong position. It is supported by a Government buying program that extends through 1966. Its production costs are competitive with those of any major producing area in the world. South Africa and Canada have larger estimated reserves because their extensive uniform deposits can be sampled with a minimum of drilling. On the other hand, we have large favorable areas for exploration and our current rate of discovery is high. Also, the average grade of domestic uranium deposits is well above the average grade of most large foreign deposits.

On the basis of our known ore reserves and the current appraisal of our geological potential, today I would not trade the uranium resources of the United States for those of any other country.

This is a far different picture from that of only a year or two ago. It is a tribute to the American prospector and the American mining industry.

The rapid increase in domestic ore reserves which followed the discovery in 1952 of the Big Indian Wash district in Utah, and Anaconda's Jackpile Mine on the Laguna Indian Reservation in New Mexico, continued at an accelerated rate during 1956. The development of the Ambrosia Lake area, New Mexico, overshadowed all other 1956 uranium developments, domestic or foreign. Anaconda's Jackpile Mine, which is about 35 miles southeast of the Ambrosia Lake structure, pointed up the importance and potentialities of the New Mexico area. The Jackpile Mine, which is estimated to contain at least 15 million tons of 0.16 percent U_3O_8 ore, still is the largest single uranium deposit yet found in the United States.

The Ambrosia Lake field as now explored extends over an area of approximately 30 square miles and the limits have not yet been determined. It contains numerous closely spaced, large uranium deposits, generally from several hundred thousand to several million tons in size. There are no outcrops. The ore found to date is from 300 to 1,000 feet below the surface. The limits of many deposits will be extended by further drilling and some deposits which are now mapped as individual deposits may prove to be part of one large ore body.

A remarkable feature of the Ambrosia Lake deposits is the thickness and grade. Average grades of from 0.25 percent to 0.5 percent U_3O_8 have been found over thicknesses as great as 50 to 90 feet. However, over much of the area the mining thickness is expected to be about 10 feet and the grade about 0.25 percent U_3O_8.

The ore reserves of the Ambrosia Lake area, which on November 1, 1956, were estimated at about 25 million tons, may now be approaching 30 million tons. This is the result of new developments which have not yet been fully evaluated. In addition, recent discoveries in New Mexico outside the Ambrosia Lake district may add substantially to present reserves.

Drilling during 1956 also greatly increased the ore reserves of the Gas Hills-Crooks Gap district in Wyoming and those of the Spokane Indian Reservation in the State of Washington.

Total domestic reserves of uranium ore, which were estimated at 60 million tons on November 1, 1956, undoubtedly will be substantially increased by the private exploration and development already planned for 1957.

At the end of 1956 domestic mill concentrate production was at an annual rate of about 8,000 tons of U_3O_8, a 100 percent increase over that at the beginning of the year. None of this production came from the Ambrosia Lake district or from the States of Wyoming and Washington. Yet these 3 new areas contain about 50 percent of our presently estimated ore reserves. As mills are constructed to treat the ores from these areas, and projects now under way in Colorado and Utah are completed, concentrate production will increase rapidly. By the end of 1958 domestic production should be in excess of 15,000 tons of U_3O_8 per year. This will mean an increase in the annual value of the uranium production of our Western States from about $150 million to nearly $300 million.

This increase in the availability of uranium—and it represents a tremendous change in a short time—naturally has had an influence on the Commission's raw-materials program.

You are aware of the changes that already have occurred in our exploration program. Drilling and other forms of physical exploration have been discontinued. Private industry today not only is doing physical exploration on a scale far greater than that reached by the Commission, but it also is carrying out extensive geological investigations. The Commission's principal geological activities now are the evaluation of the results of private exploration and development, long-range uranium resource appraisal, and basic studies in uranium geology and ore-finding techniques.

Most public lands which were withdrawn for AEC exploration have been restored to the public domain or are in the process of restoration by the Bureau of Land Management, Department of the Interior. The AEC is retaining under withdrawal orders about 50 square miles on which commercial uranium deposits have been found at Government expense. When Government drilling was at its maximum, about 1,200,000 feet a year, approximately 680 square miles of public domain were under withdrawal orders for AEC uranium exploration.

Lands retained by the Commission which have not yet been leased are estimated to contain ore reserves of about 700,000 tons. When these reserves are needed for the Government's production program, they will be offered for lease on the basis of competitive bidding. Except for the possibility of issuing a few small leases to meet special needs, these reserves may not be offered for bid for some time. Privately owned ore reserves are now adequate to meet present production schedules.

Until a year or 2 ago, if we received a proposal involving the construction of a mill with a capacity of 200 tons of ore per day, we studied the possibilities of a 400- or 600-ton mill if the speculative chances of finding enough ore appeared favorable. Several mills have been built with no more than a 3 years' assured ore supply.

Today we would like such proposals to include a reasonable prospect of at least a 10 years' ore supply for an economic size operation and a good possibility for continued operation beyond that period. The important objectives of the new AEC domestic procurement program, which extends through 1966, are to assure an adequate supply of uranium to meet the Government's requirements during the next 10 years, and to have a strong domestic uranium industry to support our future industrial needs. This means maintenance of adequate ore reserves and long-range planning on the part of the uranium producers.

It is encouraging that many producers already are planning their operating and exploration programs on this basis. Prior to the announcement last May of the extended procurement program, many operators looked upon uranium as a business to get in and get out of in a hurry. Now there is growing confidence that by the end of the current Government buying program the industrial market may support substantial uranium production.

This change to longer range production and planning is not without its problems. During the period when it was necessary to get all the uranium possible as fast as possible in order to meet an urgent military requirement, a number of projects were undertaken that were justified as emergency measures. Now that we no longer are faced with a uranium shortage, our methods of operation must be reviewed in the light of the changed conditions.

Ore producers have come to expect a market for all the ore they could produce as fast as they could produce. Now, however, ore production in an area should be at a rate consistent with the local milling operations. Both mining and milling operations should be planned, to the extent practical and economic, for a period not less than that of the extended Government procurement program.

AEC construction and operation of ore-buying stations in new areas pending the development of sufficient ore to support an economic milling operation were undertaken to speed production for defense. Ore-buying stations are costly to build and operate. Stockpiles of ore are subject to wind and erosion losses and tie up large amounts of capital. If in sufficient ore is developed to support a mill, there is the additional expense of shipping the stockpile to a mill in another area.

The operation of ore-buying stations and the accumulation of ore stockpiles in excess of current mill requirements no longer can be justified on the basis of a military emergency. Furthermore, only in periods of emergency, when concentrate production is needed in a hurry, is there justification for expensive

milling facilities to handle the short-term capabilities of the ore producers. The American Mining Congress at its last meeting expressed concern over the possibility of excess milling capacity. It urgently recommended that the Commission in contracting for mill concentrate "not jeopardize investment in nor duplicate existing milling facilities."

The uranium mining and milling industry should now plan its operations in accordance with sound commercial and business practices and not depend upon the special incentives and programs employed to stimulate emergency production.

A program that has been most important in speeding the development of domestic ore production was the construction and improvement of roads into uranium districts. Since the inception of this program in 1950, the Commission has sponsored about 82 road projects in 6 States, which resulted in construction and improvement of approximately 1,500 miles of road at a total cost to the Federal Government of more than $14 million. These road projects, which could not have been financed by the uranium miners, were essential in opening up new districts and in making the ore quickly available. Furthermore, they are of permanent value to the areas.

In the past, the Commission has requested the Congress to provide funds for the road program on the basis that the roads were needed to meet the uranium requirements of the defense effort. With the increased production, and the additional production in sight, this justification soon may no longer be valid. Fortunately, most uranium areas now have satisfactory roads, provided they are properly maintained. Under the existing program, county and State road and highway departments have the responsibility for maintenance. Increased revenues resulting from the expanding uranium operations and associated business activities should assist counties and States in financing construction of roads into new mining districts. There is no question about the value of access roads. The only question I have heard, is who should pay for them.

We are aware of the prospector's problems and the difficulties in developing a small mine into a profitable producer. Also, we have seen small mines develop into large ones. An important consideration in extending the Commission's initial production bonus program was to help the small-mine operator during the early stages of development and production. This bonus program, as you know, provides for a graduated bonus of up to $35,000 depending upon the quantity and grade of ore, for the initial production and delivery of acceptable uranium ore from new mining properties. Since the establishment of this program in March 1951, a total of more than $9 million has been disbursed in bonus payments. Payments have been made to 962 operators for production from 743 mining properties. Transfers of ownership or leases are responsible for the number of operators being greater than the number of properties.

These bonus payments have been important in assisting prospectors and miners. Prospecting and exploration should be encouraged and supported by sound Government programs. One of the problems of this country—and of the world—is an adequate supply of mineral products to meet the rapidly expanding requirements of modern civilization.

Although we now have substantial uranium reserves, our reserves of the type considered economic today are small in terms of long-range future requirements. At the present projected rate of production, 5 to 6 million tons of ore per year, they would be largely exhausted in 10 years. We are dependent upon continued discovery to maintain our position as a leading uranium producer. During the past few years discovery has been at a rate much greater than production. How long this pattern will continue, I cannot predict. However, interest in uranium is relatively recent and we have had large areas of unprospected territory in which to search. As the search proceeds, exploration probably will become more difficult and costly, and the rate of discovery lower.

At this point I would like to make some observations on the role played by the prospector and small-mine operator in our domestic uranium program. It is my opinion that without the pioneering efforts of prospectors and small mining organizations, domestic uranium production would not be where it is today. This in no way minimizes the importance of the large mining organizations—for their participation has been essential in achieving the production records.

However, during the first 3 years of the program few large mining companies were interested in uranium. Most domestic uranium deposits that had been found were small—suited to a 5- or 10-man operation. The chances of finding

deposits that would be profitable for a large organization were not considered favorable.

Charley Steen's discovery of the Big Indian Wash district and the attendant publicity first called attention to the possibility of finding large, profitable uranium mines. Cooper and Bronson developed the important Happy Jack Mine in White Canyon, Utah. Working under great difficulties and without Government assistance, they proved that a small, inconspicuous outcrop might lead to a major ore body. The first ore found in the Ambrosia Lake area was by a small company. The Gas Hills field of Wyoming was discovered by a prospector. The uranium deposit on the Spokane Indian Reservation was found by Indian prospectors looking for tungsten ore.

An outstanding exception was the discovery of the Jackpile Mine on the Laguna Indian Reservation, N. Mex. This deposit was found by the exploration activities of a large company, the Anaconda Co. Anaconda at the time was building a small mill near Grants, N. Mex., to treat ore being developed by the Santa Fe Railroad. However, the Santa Fe's ore had been found by a prospector, Paddy Martinez, a Navaho.

This record supports a statement I made in August 1950 at the American Mining Congress meeting in Salt Lake City. At that meeting I said: "I am convinced that the prospector, like the infantryman, is not outmoded. We still need the prospector." I still think we need the prospector—certainly in the search for uranium.

However, geological, geophysical, and airborne surveys are becoming increasingly important in the discovery and development of our mineral resources. Many of our most important uranium deposits do not outcrop and have been found by drilling on the basis of geological evidence. The search for subsurface deposits will become more and more important in maintaining our mineral reserves as surface prospecting gradually become less productive. Private industry already is conducting extensive geological surveys, using all of the modern scientific methods, in the search for uranium.

I am impressed by the number of new mining projects and mine expansions, other than uranium, that have been undertaken during the past 15 years under some type of wartime or military emergency. A number of the larger projects did not come into production until after the emergency, but their production was then most important to our expanding civilian economy.

The large atomic energy power development programs being undertaken in this country and in Europe, and also the atoms-for-peace program, are based upon the uranium resources developed during the past 9 years and upon the confidence that additional resources will be developed as needed. Had it not been for a military emergency, there would not be these developed resources today, nor the confidence gained from experience that additional uranium resources can be developed as needed.

The uranium emergency may be over, but the mining industry still has a 10-year Government market—a period in which to prepare for a commercial market. It is not too soon to plan for the uranium requirements that will come with atomic power. It would be desirable if future requirements could be provided by intelligent long-range planning rather than under emergency conditions or in the face of an imminent shortage.

The CHAIRMAN. Mr. Dempsey.

Mr. DEMPSEY. Mr. Chairman, you have asked most of the questions that I had in mind.

You have two plants, as I understand, two mills going up around Grants, N. Mex.?

Mr. JOHNSON. We have one mill in operation. That is the Anaconda mill, which went into operation in 1952, but the major expansion was completed at the end of 1955.

We have a contract negotiated with the Homestake Mining Co. which will process the Rio de Ono ore. That contract has been signed and I believe construction will start soon.

Representative HOLIFIELD. Will you please locate that.

Mr. JOHNSON. Near Grants, N. Mex., not far from Albuquerque. About 50 or 40 miles from Albuquerque.

Representative HOLIFIELD. What is the name of that concern?

Mr. JOHNSON. Homestake Mining Co., which operates a big gold mine in South Dakota.

Representative HOLIFIELD. When will they be in operation?

Mr. JOHNSON. They expect to be in operation early in 1958.

In the past no mills have been completed in less than about 12 months from the time they break ground and sometimes construction extends for 18 months. I think the milling construction now is handled much more rapidly with standardized equipment and processes.

Another mill is the Sabre Pinion mill. The mill contract, also with Homestake, I think, has been agreed upon, it is drafted. I would expect that might be ready for signature within a very short time.

The same thing is true with Kermac.

Representative DEMPSEY. They get the ore not far from Grants?

Mr. JOHNSON. The ore is in the Ambrosia Lake area about 20 miles from Grants and I think one of the mills will be built near Grants. One of the mills I mentioned will be built in the Ambrosia Lake area.

Representative DEMPSEY. The Sabre Pinion people are financing the mill?

Mr. JOHNSON. The Rio de Ono are ready to build the mill. Sabre Pinion will have a mill started soon. I think the contract has been agreed upon.

Representative DEMPSEY. What is the capacity?

Mr. JOHNSON. Seven hundred and fifty tons a day for Rio de Ono; 1,500 tons for Sabre Pinion. The other mill will be built by Kermac. That contract has been negotiated except for possibly a few minor details.

That will be a 3,300-ton-a-day mill.

In addition the Phillips Petroleum Co. has been discussing with us the possibility of another mill of 1,500 tons daily capacity in the area. That may not complete the number of mills that will be built in that area, however.

Representative DEMPSEY. The Sabre Pinion has a contract now, as I understand, for the purpose of ore?

Mr. JOHNSON. The Sabre Pinion owns the ore. That is, they have the mining properties and they have an arrangement with the Homestake Mining Co. for the construction and operation of the mill.

So Sabre Pinion will own the ore. The contract is practically complete for the sale of the concentrate to the Commission.

Representative DEMPSEY. I understand the Commission cooperated with the State highway department to get roads into that area?

Mr. JOHNSON. We have had some cooperative road programs in the area; yes, sir.

Representative DEMPSEY. Thank you very much, Mr. Chairman.

The CHAIRMAN. Does Canada now sell ore to all nations?

Mr. JOHNSON. Up to the present time all of the Canadian uranium production has been sold to the Commission except for such quantities as Canada has reserved for its own use. Canada recently announced a program under which it will sell small quantities of natural uranium or concentrate to friendly foreign countries and I think that the quantities are quite limited and that the material will be largely for research.

Canada does have in mind the possibility of commercial sales or sales for industrial uses on a larger scale later on. The Minister in making

the public announcement in Canada only a short time ago, referred to the fact that most Canadian uranium was now covered by contractual commitments.

The CHAIRMAN. I believe your buying program first extended to 1963 or 1962.

Mr. JOHNSON. You mean with Canada?

The CHAIRMAN. No; domestically.

Mr. JOHNSON. Our domestic program until last May extended to March 31, 1962. That was an ore-buying program although the Commission bought only a small percentage of the ore. We established the ore prices but negotiated contracts with private milling companies for the concentrate.

From March 31, 1962 through 1966, the end of 1966, the new procurement program provides a market for a mill concentrate at $8 a pound.

The CHAIRMAN. Then it is more or less firm until 1966?

Mr. JOHNSON. Yes, sir.

The CHAIRMAN. Is it possible for the Commission to take a look at the price of this ore during that period of time and make any changes in it?

Mr. JOHNSON. We have made a firm commitment for the concentrate from March 31, 1962 through 1966 subject to some restrictions on quantities.

In response to question No. 3 that was presented to us, I have prepared this answer:

(Question 3. Has the large uranium supply and reserves caused the Commission to have another look at its pricing policy in the purchase of uranium? [Editor.])

The Commission has under continual review the cost of uranium production and its pricing policies. The domestic concentrate price of $8 per pound of U–308 for the period March 31, 1962, through December 31, 1966, appears realistic, and reasonable, based upon the current purchasing price of the dollar. However considering both domestic and foreign uranium sources now in production, there is a question as to the extent that this price will support the construction of new facilities without the addition of an amortization factor.

The $8 price I believe is the minimum that could support major world production from facilities that will have been amortized by March 31, 1962.

I would not expect any additions, new facilities, to be built in South Africa on the basis of an $8 price. I would doubt if many or if any would be built in Canada with that price for the type of ore deposit now mined.

The CHAIRMAN. Then you do not think and do not believe that it will be possible for this offshore ore, in case it does develop, to more or less get us in the same position that some of the offshore materials have gotten us in, in the strategic stockpiling program, where they shipped it in at a very low price and speeded the problem of closing up our mines.

Mr. JOHNSON. I wonder if I could read a paragraph from my Denver talk:

As we enter the era of atomic power the American uranium industry is in a strong position. It is supported by a Government ore-buying program that ex-

tends to 1966. Its production costs are competitive with those of any major producing area in the world.

South Africa and Canada may have larger estimated reserves because of their extensive uniform deposits which can be sampled with a minimum of drilling. On the other hand, we have in the United States large favorable areas for exploration and our current rate of discovery is high. The average grade of domestic uranium deposits is well above the average grade of most large foreign deposits.

On the basis of our own known ore reserves and geological potentials today, I would not trade the uranium resources of the United States for those of any other country.

Now, that is quite a different statement than could have been made only a year or two ago. We are in a strong position competitively, costwise, and from the standpoint of total resources.

The long-range program that we have announced has had the effect, Mr. Dempsey is aware of it in the Grants area, of having companies that are now going into the business plan their production schedules not only through the period ending in 1966, but also looking forward to the period after 1966. Their ore reserves will not be exhausted by the end of the AEC program.

Representative DEMPSEY. Mr. Johnson, the mine people in New Mexico engaged in uranium very highly approved your speech in Denver. I thought you would not mind my telling you that.

Mr. JOHNSON. Thank you, sir.

The CHAIRMAN. It gives me great comfort, of course, to have that kind of assurance. I probably get a little too much concerned because I remember the early days from 1939 and 1940 to 1943 when we did not have very much, and I am always afraid we may get ourselves in a position of neglecting our own domestic mines and depending too much on offshore materials.

The CHAIRMAN. Mr. Holifield.

Representative HOLIFIELD. Did I understand you to say that we are in such a sound position that we are competitive for instance with deposits like the Belgian Congo?

Mr. JOHNSON. We are competitive on the basis of cost of production with any major producing company.

The CHAIRMAN. Are there any further questions?

Thank you very much.

This afternoon we will meet in F–39 over in the Capitol. We will defer the questions on the international agency until this afternoon since Senator Pastore is chairman of that subcommittee and wants to be present.

And we will take up the Yankee question also this afternoon at 2 o'clock.

Mr. FIELDS. Am I to understand you will limit the hearing to that this afternoon, sir?

The CHAIRMAN. That is all.

Mr. FIELDS. So that I can excuse some of the others?

The CHAIRMAN. That will finish this hearing this afternoon.

Thank you very much.

The committee is adjourned until 2 o'clock.

(Thereupon, at 12: 15 p. m., the committee was recessed, to reconvene at 2 p. m., same day.)

AFTERNOON SESSION

(The committee reconvened at 2 p. m., upon the expiration of the recess.)

The CHAIRMAN. The committee will come to order.

In the continuation of the hearing from this morning we carried over chapter No. X. I understood Senator Pastore wanted to be present.

So we will take up chapter X. I will ask Mr. Ramey, the executive director, to ask the questions.

Mr. RAMEY. The first question is: Is there a new policy being developed with respect to power bilateral agreements, and what is that policy?

Mr. FIELDS. Mr. Chairman, I am not aware of any new policy unless it is perhaps the feeling on our part that because of the extensive declassification of information that is now possible, that most of the power bilaterals, practically all of them, could be of an unclassified nature. This may be what the reference is to.

With the new basis for declassification, I think we feel that we do not at the moment foresee why a power bilateral cannot be unclassified in most cases.

Representative COLE. Would you mind repeating the countries with whom power bilaterals have been made?

Mr. FIELDS. Mr. Vogel has a little more complete information. I have it, but I might forget it.

Mr. VOGEL. We have classified power agreements with United Kingdom, Canada, Belgium, Australia, Switzerland, the Netherlands.

We have an unclassified agreement with France and an agreement that is presently before the Joint Committee, pursuant to statute, with, the Government of Norway. This agreement was submitted to the Joint Committee on February 26 and is printed in the Congressional Record for Friday, March 1.

This is unclassified and will more or less act as a prototype for the agreements which we are now negotiating with some 15 countries.

Representative COLE. What is the difference between the two types of agreements?

Mr. VOGEL. The classified agreements call for the exchange of restricted data in the power-reactor field and have attached agreed security arrangements between the two Governments.

The Norwegian agreement provides for an exchange of unclassified information only. This eliminates the necessity for negotiating security arrangements with the cooperating country.

Representative COLE. Were those not restricted or classified agreements made before the last declassification made by the Commission?

Mr. VOGEL. Yes, they were, sir.

Representative COLE. And in the light of that recent action does the commission now consider it necessary that they be and remain classified agreements?

Mr. VOGEL. We have no plans, sir, to initiate renegotiation of the agreements to convert them from classified arrangements to unclassified arrangements.

However, if a cooperating country should so desire, I am sure we would be receptive.

Representative COLE. In the light of the declassification of recent months, if those agreements which we now call classified agreements were to be made, would they nevertheless be classified agreements?

Mr. VOGEL. No; they would not.

Mr. FIELDS. I would have to look at that in some detail, Mr. Cole. I think there is a section or two in there that might still call for the exchange of classified information. I have in mind, for instance, in United Kingdom there is the possibility of exchange on the controlled thermonuclear program, for example, elements of which are still classified.

Representative COLE. Is it contemplated in the future there might still be classified agreements?

Mr. VOGEL. I don't think we would like to foreclose there being classified agreements if there is a reason for it.

Representative COLE. How would the Commission determine whether an international agreement is to be a classified agreement or unclassified?

Mr. VOGEL. I think it would depend on the area in which we wish to collaborate. There is still some classified information in our books regardless of this declassification.

Representative COLE. Will the conflicting groups be the cause of any embarrassment in dealing with foreign countries, selecting some for classified work?

Mr. VOGEL. I think it could be, sir. It certainly would take careful consideration at the time we were looking at those agreements and in negotiations.

I think by and large they will be unclassified. We have no classified ones under negotiation at the present time.

Representative COLE. What does that show, seven power agreements?

Mr. VOGEL. It is eight, I think.

Representative COLE. How many are under consideration?

Mr. VOGEL. Some 15 or 16.

Representative COLE. Not including the one that is pending?

Mr. VOGEL. Not including that one. I included that in the eight.

Representative COLE. Have those countries been named in the record previously?

Mr. VOGEL. They are set out in the 21st semiannual report.

Representative COLE. It won't take but a minute; so for the record why do you not enumerate the names of the countries with which we are now discussing power bilaterals?

Mr. VOGEL. Discussions are in progress with the Governments of Argentina, Brazil, Cuba, Federal Republic of West Germany, Israel, Italy, Japan, Pakistan, Philippines, South Africa, Spain, Sweden, Thailand, Tunisia, and Uruguay.

Representative COLE. With whom are we discussing, if anybody, the proposed power station in Berlin?

Mr. FIELDS. I am not aware of a proposed power station in Berlin. There is a research bilateral.

Representative COLE. It is not intended to be a power station?

Mr. FIELDS. No, sir.

Under consideration is a bilateral to permit the construction of a research reactor in the city of Berlin.

Mr. MITCHELL. I think I should point out that the bill which we suggested, the counterpart of which you introduced, is stated broadly enough to permit a power bilateral although it is not the intention of the Commission at the present time to do anything more than to provide a research bilateral.

Representative COLE. With what country would you negotiate that, Berlin, I mean?

Mr. MITCHELL. The bilateral itself would have to be executed by the West German Republic since the West German Republic handles the foreign affairs for the city of Berlin.

But we would contemplate also having understandings with the Allied Governments in Berlin before we proceeded to execute the bilateral.

Of course, prior to that we would have to have an amendment to the Atomic Energy Act.

Representative COLE. I do not understand why you would have to have understanding with the Allied Powers if the sovereign power having jurisdiction over Berlin is West Germany.

Mr. FIELDS. That is the question. The Allied Command has jurisdiction.

Mr. MITCHELL. I think maybe I can clarify this. The Federal Republic of West Germany handles the foreign affairs of the city, but the internal management is under a parliament which is subject to the control of the three occupying powers, so that there is a division in effect.

Representative COLE. Only because this agreement does involve foreign affairs?

Mr. MITCHELL. Yes, sir.

Representative COLE. Therefore, West Germany in respect to its operation, nature, and purpose and so forth, then the Allied Powers.

Mr. MITCHELL. The Allied Powers will be the ones that will control the actual proceedings under the bilateral.

Representative COLE. Do you have two bilateral agreements, one with West Germany and one with the Allied Powers.

Mr. MITCHELL. If the act is amended the bilateral will be made with the Republic of West Germany on behalf of the city of West Berlin.

Senator PASTORE. There is one question I should like to ask.

Do you know of any instance where a private American firm is deterred in any way from reaching an effective agreement with a foreign government insofar as a reactor is concerned for lack of a bilateral with that country.

Mr. VOGEL. I know of no such instance. There are plans for the construction and operation of power reactors in three Latin American countries by an American operating company and the countries involved are countries with whom we do not at the present time have bilaterals, but with whom we are now negotiating bilaterals.

Senator PASTORE. There is another question that I should like to ask. I shall not press for an answer if you feel you would like to think about it.

At the time that the President suggested to the Assembly of the United Nations in December 1953 the idea of an international agency for the peaceful atom, of course, we hardly had any bilaterals at the

time. Now we have reached the point where we have a bilateral with practically every freedom-loving country in the world and if we do not have one already, they are in the process of negotiation.

That leads me to this question: How are we going to coordinate this with the International Agency and how are we going to defend our participation in the International Agency if we have a bilateral with every country with whom we have bilateral agreements?

Mr. VOGEL. Senator Pastore, in all of our major agreements, and by that I means all of our power agreements, we have negotiated a provision under which both of the cooperating countries affirm their common interest in the establishment of an International Atomic Energy Agency and it is provided that when such an agency comes into existence the parties will consult with each other to determine in what respects they desire to modify the provisions of the agreement for cooperation, particularly to determine in what respect and to what extent they desire to arrange for the administration by the International Agency of conditions relating to controls and safeguards against diversion and relating to health and safety standards.

The International Agency is a very important channel through which we will send our cooperation to other countries of the world, but I do not think at this time, and in the next few years, it will exclude bilateral arrangements.

On the other hand, I do not believe that continuation of bilateral arrangements will in any way seriously impair the effectiveness of the International Agency.

Senator PASTORE. Then you feel even though we have talked about an international agency we have been right in our determination and our expedition in negotiating bilateral agreements with other governments in the meantime?

Mr. VOGEL. I do indeed, sir.

Senator PASTORE. And the fact that there may be agreements with practically every free nation of the world, or those we consider to be on the side of freedom and our side, that even then that ought not to discourage our participation in the International Agency?

Mr. VOGEL. Yes, sir.

Senator PASTORE. The reason why I bring up the point, and you know how I feel about the International Agency and how I feel about our bilaterals, is that I think it is going to be one of the big arguments used against the agency as such.

The argument is going to be made if we have bilateral agreements with all of these countries with whom we should like to do business and do business, then the only efficacy of the International Agency would be to allow this material and this knowledge to go to countries with whom ordinarily we would not care to do business.

That is going to be a big argument. It will have to be overcome if you expect to put it over. Do you not agree with that?

Mr. VOGEL. Yes, I do, sir.

Representative COLE. Who in the Commission, if anybody, is spearheading assistance to American manufacturers of reactors in order to assist their sales of reactors abroad?

Mr. VOGEL. I think it is a combined effort of several of the divisions in the Commission, notably the Division of International Affairs and the Division of Reactor Development. I think it is fair to state that

both of these divisions devote a large part of their time in rendering assistance to American industrial concerns doing an international trade.

(For pertinent correspondence from AEC, see letter dated March 26, 1957, p. 725.)

Representative COLE. One of those two divisions is your division?

Mr. VOGEL. Yes, sir.

Representative COLE. I have the impression that you are pretty much preoccupied in furnishing the legal framework in which American manufacturers can operate abroad. That is not the kind of spearhead I am talking about, not the legalistic spearhead.

I am thinking more of the business end of it, economic rather than political. Is there anybody in the Commission?

Mr. FIELD. The Division of Reactor Development does for the technical aspects of the power reactor programs abroad, and we attempt to follow the progress of negotiations that companies are having with foreign countries.

We are examining our various policies to see what we should do in the way of furnishing materials, the pricing of materials, the chemical processing of fuels.

In this area we are attempting to set this up on as sound a basis as we can.

Representative COLE. As I see it, our principal competitor is the United Kingdom. It appears that potential buyers in a foreign country in negotiating a reactor, when they come to deal with the United Kingdom there is a government man sitting on the opposite side of the table speaking with a large measure of authority as well as the English manufacturer.

Now, there apparently is no such man sitting at the negotiating table comparable to the Bristish Government man.

Mr. FIELDS. I believe that is correct. We have done what we can to facilitate the meeting of foreign governments or representatives when they come here, with industrial people in this country, or firms, to help in every way we could there, to take them and give them all the information that we can and that we have on our own facilities.

But it is certainly true at the negotiating table the Government does not have a representative.

Representative COLE. What are the reasons why?

Mr. FIELDS. Basically I would say we don't at the moment have a program where this Government is underwriting the sales of reactors abroad, underwriting in the sense of guaranteeing production and sale.

Representative COLE. Is that necessary that that condition exist in order for a Government man to sit there and give advice?

Mr. FIELDS. We have been at some meetings. When the "three wise men" met with industry representatives in New York there were several of our people there. Mr. Vander Weden from the Division of International Affairs was there.

As a matter of fact, Commissioner Vance was there also.

We had times when we met concurrently when industry was talking to the representatives, but I would not say we were a part of the negotation. We had not approached it on that basis. Maybe we should do more in this field.

The CHAIRMAN. What part does the State Department play?

Mr. FIELDS. I don't believe they take any part in these specific negotiations of firm contracts.

Representative COLE. It just seems to me it might be a very helpful gesture. I think it is an incorrect word because I think it should be more than a gesture. It would be a helpful tool if the Commission did have somebody whose responsibility was to give assistance to American manufacturers in their dealings abroad, to remove kinks and conflict of laws and such, as well as to advise the American manufacturer on the terms extended by the bilateral agreement, limitations and so forth.

Mr. FIELDS. We have been doing a great deal of discussions with equipment manufacturers and others, attempting to clarify our arrangements.

On the three power reactors you mentioned in South America, we had quite close relations.

Representative COLE. Have you had any complaint from American manufacturers that there is no such person from the Commission?

Mr. FIELDS. I don't believe we have had a complaint that we have no such person in the Commission. I don't know of any complaint.

They have difficulties, don't misunderstand me. They don't have bilateral agreements sometimes. They are interested in maybe more long-term guaranties of fuel availability, things of that nature.

But I am sure that Mr. Davis or the Division of International Affairs—Mr. Hall is not here—could recite any number of instances where we sat down and discussed at length things with industrial people.

The CHAIRMAN. There has been some discussion that we need a more aggressive program. Suppose Congress laid down such a policy, what would you think of it, as suggested by Mr. Cole?

Mr. FIELDS. I think we are doing a great deal in attempting to help the people at the moment, a great deal of effort in trying to come up with policies that will lay the groundwork so that there can be effective industrial cooperation in the building of reactors abroad.

Just what kind of dictum from Congress it would take to change this, I am not prepared to say at this moment.

Representative COLE. Probably the conditions at the moment are not so acute to require such a person. Naturally, you have to lay a groundwork before any international business in this field can be done, but it seems to me the time we hope is coming very soon when such a person would be advisable.

Mr. FIELDS. I would like the committee to understand we are doing a great deal of thinking and planning in this area. We have under consideration, for instance, legislation of this nature that will permit us to apply the buy-back price for more time than we can now for foreign reactors. We are thinking of submitting this for a possible legislative change.

Similarly, the authority to enter into long-term contracts with foreign countries for the chemical reprocessing of their fuel. We have quite a bit coming along of this nature that we have under consideration which will assist American industry greatly, we believe.

Senator PASTORE. If a foreign government, for instance Japan, decided to buy, through the process of a bilateral with Great Britain,

the United Kingdom, the reactor, the fuel, and also enter into an agreement to sell back the byproduct of the reactor, they would do that in a package deal, would they not?

Mr. FIELDS. I have heard they have package deals. I don't know to what extent it is a complete package.

Senator PASTORE. According to our bilaterals all we can talk about is the fuel that we will sell and the byproduct that we will buy back, but we have a sort of hiatus there as to where they can go and buy the reactor, from what company in America, and what reactor they can buy. Is that not so?

Mr. FIELDS. They have to shop around in American industry.

Senator PASTORE. On their own. Now, what part do we play?

Mr. FIELDS. They come here initially. We outline itineraries for every group that comes here practically.

Senator PASTORE. You tell them the companies they can go to?

Mr. FIELDS. Yes, sir. They have many contacts of their own, of course. Firms like Westinghouse and General Electric and others already have their overseas representatives in most of these countries. So when these groups come to this country they have a pretty full itinerary, visiting our plants and discussing the problems with American industry, equipment manufacturers and others.

It is on the question of getting right down to the final agreement and signing that you are going to build it for this much that we are not quite in a position at the moment to say what the Government part should be.

If a company is going to commit themselves to build a reactor at so much for the moment we can only step in and say we will guarantee the fuel for so long, or we will reprocess the material when it comes back.

Representative COLE. Who do you have in the Commission that would advise the prospective purchaser regarding the financing of the project? All you would do is say, "Go across the street and see the Export-Import Bank," or "Go across the street in New York and see Chase Manhattan."

Mr. FIELDS. That is all we have the authority to do; yes, sir.

Representative COLE. You do not have anybody to advise them on financing, the availability of financial assistance from sources here in this country?

Mr. FIELDS. We can indicate what has been said, what the bank has indicated they would do, and introduce them to the right people in the bank. That is correct; yes, sir. It is the sort of thing we would do at the present time.

Representative COLE. Have you given any thought of suggesting that to the Export-Import Bank designating one of its own people to come over and live with you folks for a long period of time? Do you have somebody in your building that you call in immediately, or send the prospective buyer to immediately to discuss possible financing rather than having him go out and making apponitments on his own?

Mr. FIELDS. Well, we have made a lot of appointments for many of these teams and we have had many of our representatives follow them on their whole trip actually.

I am not sure whether we have gone with them when they have gone to the Export-Import Bank, or not. I see your point, Mr. Cole. It is a good one.

Mr. VOGEL. I think the record should show that whereas we do not participate in the negotiations between a country and an American industry, we are very active in sitting down with both parties after the agreement has been entered into to try and assist them in implementing that agreement.

For example, in the past 2 weeks, I have met at least a dozen times with an American equipment manufacturer and a representative of Edison-Volta to help them implement their letter of intent.

Senator PASTORE. So for all practical purposes we do have an overall coordinated way of negotiating these.

Mr. FIELDS. We certainly are attempting to help all along the line.

Representative COLE. My attention has been brought to the panel report, the McKinney report, which has made this recommendation. It says:

> Peaceful uses of atomic energy will inevitably be developed throughout the world. The United States must lead. Therefore, we recommend * * *(2) that the Commission center its responsibilities with respect to international development of peaceful uses of atomic energy in one alert, forward-looking organizational unit.

I judge from what you say you are trying to do that, but you have not organized it into a single unit.

Mr. FIELDS. I am not sure you can put it in a single unit, there are many different facets to this.

Our Division of International Affairs really has the responsibility to see that when someone comes to this country and the foreign country has a problem, that it gets every bit of help and assistance that it can whether it comes from one division or the other of the Government.

I think that to say it has to all be in one package and nowhere else, that is not realistic. I don't know how many visitors we have had to this country, but there have been hundreds and hundreds of them that have been in.

Representative PRICE. General Fields, while you are on this subject, has the Commission ever been requested by any foreign government to send a representative of the Commission abroad to discuss with officials of the country a power reactor program?

Mr. FIELDS. I believe we have. We have had teams that have gone and visited quite a number of countries. Specifically to go over and discuss the power reactor program of a country? It inevitably happens in the trips that have been taken.

Representative PRICE. Do you have any specific request from any one government to send someone over to talk about power reactors?

Mr. FIELDS. I don't know any right at the moment. There was under discussion someone going to Japan to talk about them, but that was deferred for the time being.

Representative PRICE. Wasn't there an invitation from India?

Mr. FIELDS. I would have to check that.

Representative PRICE. Has the Commission sent any representative abroad in the last 6 months or 8 months?

Mr. FIELDS. Oh, yes; quite a number of them. There was an Indian research center opened. There were three that were sent there. There was a group sent to South America.

Representative PRICE. Was the Commission requested to send a representative of the Commission, a Commissioner, for instance? Were they invited to India or Japan for the specific purpose of discussing the power reactor program?

Mr. FIELDS. Well, the Chairman, I believe, was invited to India. I am not sure it was to discuss the power reactor program. They were dedicating a research center there, and he was issued a specific invitation to go to that, but I am not sure it was to discuss their power reactor program.

Representative PRICE. Did you send a representative?

Mr. FIELDS. Yes, sir; there were three representatives, General Nichols, Dr. Bugher, and Dr. Berkner, I believe it was. There were three of them.

Representative PRICE. Their purpose was merely to represent the Commission at the dedication of a research center?

Mr. FIELDS. In this particular instance; yes, sir.

Representative PRICE. No specific reference to discussions of a power reactor?

Mr. FIELDS. Not that I am aware of. I would have to check back on this. I am quite certain it was an invitation for this purpose that came through the Embassy.

Representative PRICE. As far as you know that was the only purpose of the visit?

Mr. FIELDS. Yes, sir.

To go a little bit further on this question, I think you will be talking tomorrow in Senator Pastore's subcommittee with a number of our staff who will be going to Europe to collaborate and assist these "three wise men" in a study they are preparing. We are doing some things of that nature.

Representative PRICE. I might say I was prompted to explore this matter because there has been a feeling among some in industry based on the belief that this mission was for another purpose.

Evidently their concern was based on an erroneous appraisal of the mission.

Mr. FIELDS. It must have been. I have given what I know about it. I am quite certain that is correct, too.

Representative PRICE. I am not questioning it, but the matter came to my attention. That is the reason it was brought to my attention.

The CHAIRMAN. That completes the questions, I believe, that we had, General Fields.

(The letter from AEC, referred to on p. 721, follows:)

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington, D. C., March 26, 1957.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. DURHAM: During the section 202 hearing on March 5, 1957, certain questions were raised concerning the assistance given to American industry in the matter of selling United States reactors abroad.

As explained in the testimony, representatives of the Commission do not participate in the private negotiations between United States industrial firms and a cooperating country or its nationals. As an agency of the Government we feel

that such participation would be inappropriate, especially in view of the Commission's objective of assisting both parties to the fullest extent possible. Moreover, we are confident that American industry would consider Commission participation in its contract negotiations as an unwarranted intrusion into its private activities and arrangements.

This should not be taken, however, as indicating that the Commission's interest in foreign sales of United States reactors is limited to providing the legal framework for private activity abroad through the negotiation of agreements for cooperation. On the contrary, we endeavor in every way possible to assist both American industry and cooperating countries, both before and after the negotiation of a commercial arrangement.

Commission staff members participating in the negotiation of agreements for cooperation invariably discuss with the representatives of the other countries their prospective atomic energy programs and plans and United States assistance in furthering these objectives. Such assistance includes technical discussions related to the several types of available American reactors, visits to AEC installations for purposes of examining those types of reactors firsthand, and arrangements for the development of industrial contacts. Assistance to industry at this stage is in the form of advice concerning the proposed programs of cooperating countries, the particular interests expressed by foreign representatives, and the appropriate contacts which should be made. The Commission's Division of International Affairs devotes considerable time and effort in this latter activity which industry has found to be particularly helpful, although in many instances the international sales organizations of United States equipment manufacturers will have made the necessary contacts in advance.

The statistics relating to the visits of foreign nationals to the Commission's Washington office and to field installations provide a good indication of the scope of AEC activity in providing cooperating countries with the background and orientation necessary to enable their representatives to conduct knowledgeable discussions with private industry. During 1956, for example, 812 foreign nationals and embassy personnel representing 48 countries visited our Washington office for purposes of discussing the implementation of agreements, including the purchase of reactors. During the month of February 1957, alone, 107 foreign representatives visited for these purposes. Similarly, during 1956, 575 foreign visits were made to AEC field installations. No statistics are maintained with respect to contacts with American industry concerning foreign activity, but these contacts are frequent and of considerable volume.

The number of foreign sales of reactors by United States industry reflects the value of the type of assistance rendered by the Commission. We have been informed by industry that 17 United States research reactors have been sold abroad, and contracts or letters of intent have been signed for 8 power reactors to be installed and operated in cooperating countries. No other country, so far as is known, can match these figures; and in the relatively short time which has elapsed since the atoms-for-peace program got underway, this is considered a high degree of progress.

Commission assistance does not end with the signing of a commercial arrangements between a private United States concern and its foreign customer, since both parties look to AEC to help in the implementation of the agreement in a number of ways. Many of the arrangements, for example, are subject to a number of conditions to be met prior to final consummation. Whenever it can, the Commission assists the parties in working out these conditions as expeditiously as possible.

Further, many of the substantive policy determinations which have been made in connection with the bilateral program are the result of a desire to provide favorable conditions for United States industrial activity abroad. The more important of these policy determinations are detailed in the prepared material submitted to the joint committee prior to the opening of the section 202 Hearings.

Our extensive contacts with American industrial concerns engaged in foreign sales activities have not resulted in any substantial complaint concerning lack of Commission assistance.

Sincerely yours,

K. E. FIELDS, *General Manager.*

Now we will go to the report on the Yankee Atomic Electric Co. I believe you have a statement on that, Mr. Fields.

Mr. FIELDS. Yes, sir, Mr. Chairman; I have a statement I would like to make, with your consent.

The CHAIRMAN. You may proceed.

Mr. FIELDS. In response to the audit report by the General Accounting Office of the contract with the Yankee Atomic Electric Co., we have previously transmitted to your committee a copy of our comments to the GAO on a draft of the present report, together with a letter to your committee which dealt specifically with the three recommendations in the report.

It is believed that a brief review of the history and purpose of this contract is pertinent to a discussion of the GAO report.

In response to the Commission's first-round invitation to industry for proposals to construct and operate reactors in the interest of the acceleration of the development of atomic powerplants, a group of 12 New England utility companies sponsored, through the Yankee Atomic Electric Co., a proposal to construct and operate an advanced type pressurized water reactor of 134,000 kilowatts of electrical capacity.

The sponsoring utility companies are the following:

New England Power Co.
The Connecticut Light & Power Co.
Boston Edison Co.
Central Maine Power Co.
The Hartford Electric Light Co.
The Connecticut Power Co.
Western Massachusetts Electric Co.
Public Service Company of New Hampshire.
Montaup Electric Co.
New Bedford Gas & Edison Light Co.
Cambridge Electric Light Co.
Central Vermont Public Service Corp.

After negotiating with the company and following further refinements of its own plans, we entered into a contract on June 4, 1956.

Under the terms of this contract, the company agreed to construct the reactor with its own funds at a capital cost of approximately $35 million. The company also agreed to operate the reactor at its own expense and the sponsoring companies agreed to purchase the electricity therefrom.

Since the proposed reactor is of an advanced type, it was recognized that a substantial amount of research and development would be necessary prior to final design and construction. Since such research and development would be of continuing benefit to the design and improvement of pressurized water reactors of the future, the Commission agreed to provide specified research and development work at a cost of $5 million.

One million dollars of this work will be performed in the Commission's own laboratories, and $4 million thereof will be performed by Yankee's reactor designer, the Westinghouse Corp. Any cost of research and development work in addition to that provided by the Commission will be at the expense of the company.

In addition to this research assistance, the Commission agreed to waive the use charge on special nuclear materials for a period of 5 years of initial operation in recognition of the fact that the early years of the operation of the reactor would necessarily be experimental in nature and therefore uneconomic. The estimated reduction in cost

to Yankee by reason of this waiver for the 5-year period is approximately $3,300,000.

In summary, the Commission is providing $5 million of research and development work and is waiving the use charge for special nuclear material for 5 years of operation.

In return for this assistance, the Commission receives full and complete information regarding the design, construction, and operating experience of the reactor. The company provides all capital costs, all costs of operating the reactor, and the cost of any research and development beyond that provided at the expense of the Commission.

Since the signing of the contract, work has been progressing on schedule on the design of the reactor and on the research and development of the reactor core and other reactor components. It is expected that preliminary design will be available in June of this year and that the initial phases of construction will start in the fall of this year. Actually, they have selected a site, as you know.

As stated to you in our letter, we do not find ourselves at variance with the report of the GAO in respect to the general principle that the Government, when entering into contracts, should have assurance that sponsors of a company provide binding agreements covering their capital contributions. It must be remembered, however, that in this case a substantial amount of developmental and design work was necessary to develop firm cost estimates upon which to base complete financial arrangements.

It was our opinion at the time we entered into the contract that firm capital financing of construction need not be available during the initial research phases of the project, especially since the Commission would receive the benefit of any research for which it paid.

Last fall the board of directors of the sponsoring companies passed resolutions expressing their continuing interest in the project and their intention to subscribe their proportional shares of up to $18 million of capital stock at the appropriate time.

The sponsors have to date provided to the company $2 million in interim funds, which are adequate to cover the architect-engineer and other work being performed during this phase of the scheduled work.

The company has assured itself that it can secure necessary debt financing in appropriate amounts at the appropriate time. It is naturally not prudent for the company to enter into agreements in this respect which would call for the premature payment of commitment fees.

As stated in our letter, we will continue to follow the progress of the work and the consequent completion of the necessary financing.

The GAO report also recommends that:

> The Commission obtain from the sponsors a guaranty that the applicant will perform the work contemplated in the proposal.

We have recently been informed that, despite projected increases in cost over those contemplated in the original proposal, the company and its sponsors remain firm in their plan of proceeding.

We know of no circumstance at the present time likely to impair the performance as contemplated. We do believe, however, that on a developmental project of this nature it may not be reasonable to

demand a guaranty, irrespective of obstacles which might arise which might prove insurmountable, that the work will proceed regardless.

The GAO report also recommends that, in regard to future negotiations:

> AEC obtain the right to audit all transactions related to the contract. * * * This recommendation is directed to giving to the Commission the opportunity to assure itself as to the accuracy of cost and other financial data prepared by the contractor.

The present contract contains a clause giving the GAO the right to audit all transactions under the contract whether or not they involve the expenditure of Government funds. While, of course, we, the AEC, will audit in detail the expenditure of AEC funds involved, we believe that our principal concern in respect to the expenditure of company funds is the right to receive full information regarding these costs and to make such examination of the company records as may be necessary for this purpose.

There is a clause in the contract which provides that the company agrees to provide the Commission with all information of a technical and economic nature which we may request. We are confident that we are in a position to secure all of the information regarding this reactor which is pertinent to the furtherance of the economic development of nuclear power.

In the body of the report, the GAO discusses what they term a change in policy in the waiver of the use charge from a period of about 2½ years of operation to a period of 5 years of operation, and comments that the contract "does not specify any limitation on the amount of money of the material use charge waiver."

In our letter to the GAO, we fully covered the reason for the change in the period.

Briefly, this change was made to be more expressive of the intent of the Atomic Energy Commission since it affords equal benefits to all proposers by allowing for variations in the time required to negotiate contracts and to carry out the development, design, and construction phases of the project.

We also stated that it was not possible to provide a specific monetary limitation on the use charge because of the initial uncertainties as to the precise quantity of material in the core or the precise operating experience. The Atomic Energy Commission maintains control of the material employed, however, through its allotment of material under the license.

In this statement I have attempted to cover the highlights of the contract in relation to the GAO report.

In closing, I would like to emphasize that we are following the conduct of the work closely and we believe that it is progressing satisfactorily as scheduled. Beyond that, it is my belief that, if the efforts of Yankee and its prime contractors are encouraged and continued to completion, this country, as well as others, stand to gain immeasurably. For the project will demonstrate the economics of an advanced PWR design—and the Yankee management seems to be imbued with a good deal of Yankee tradition to get the most out of their dollar. Already, several other concerns have shown interest in this design.

The CHAIRMAN. Senator Pastore.

Senator PASTORE. In order to bring this into proper perspective, the fact of the matter is that in this case they are spending $4 million on research which we will reimburse the company for; is that right?

Mr. FIELDS. Yes, that is on a subcontract we have approved.

Senator PASTORE. What is the procedure under which that works? Is it not necessary for them first to spend this money and allow us to audit how they have spent it, and then we reimburse them under that contract?

Mr. FIELDS. That is correct. We have the audit right; we audit for expenditures of Government funds.

Senator PASTORE. Is it your feeling that even though, and we assume that that is not the case, there was no activity in furtherance of carrying out this project, that we will have spent every penny wisely in the research and development that took place?

Mr. FIELDS. I think there is a value from the research that will be done on our part, Senator.

I cannot answer that we would do it now or immediately if the Yankee target was not set for the construction of this reactor. It is valuable information that is being developed in the research and development that is being done in the design of the fuel elements to the reactor.

Senator PASTORE. It was my understanding, until I read your statement today, that they had expended $1 million. I read here on page 4 that it is $2 million.

Mr. FIELDS. They have not expended that much.

Senator PASTORE. They have committed themselves.

Mr. FIELDS. They have committed themselves.

As I understand it, the sponsoring companies have purchased a million dollars in stock of the Yankee Co. and have authorized the loan of another million dollars by Yankee, so that they have $2 million.

Senator PASTORE. Now, with reference to this waiver, it is your considered opinion that it had to be raised from 2½ to 5 years?

Mr. FIELDS. When the first round was started, we had announced that we would waive the fuel use charge for 5 years. Now this is the 4 percent charge on the amount of money corresponding to the material that is in their pipeline or inventory. It is not the burn-up.

We announced this at the same time the first round was announced. During the course of this, it became very clear that what this did was of no benefit to most of the companies because it is 3 or 4 years from the time you start before you have a reactor operating.

So the Commission adopted a policy that for all comers on these kinds of projects that you should offer to waive the fuel use charge for 5 years of operation, recognizing that the usual course of reactors as it will be in the PWR and others, is that you will put in the first core, you will operate it and you will want to modify it, you will have development and design working on for probably at least 5 years of operation, and perhaps for this reason in encouragement, the Government should waive the fuel use charge for anyone in the power demonstration programs.

Senator PASTORE. All I desire to say on this point is that there has been a tremendous amount of enthusiasm, and I have joined in that enthusiasm, of interesting the Government in the expenditure of $4 million in order to build their own reactor.

Here we have an opportunity to expend on the part of the Government, as I understand it here, about $8,300,000. One million of that will be spent by the Government in its own research, $4 million of it, of course, will be spent by the company in research and they will be reimbursed by us after they have spent it, plus the fact that this research will have to prove successful before we get into the business of supplying the fuel elements.

It strikes me, in view of our desire to get on with this job, that while there may have been certain other things that might have been done in a different way, I am one of those who feels that this is a good contract between the Government and these 12 companies through the Yankee Atomic Electric Co., and I think it carries out the spirit and the enthusiasm on the part of the Congress and the United States to get this job underway and get it done.

Mr. FIELDS. I certainly concur with you, Senator.

Representative COLE. What was the genesis of this study by the GAO? Do you know, General?

Mr. FIELDS. No, sir; except that the GAO habitually looks at our contracts. I believe they felt, this being the initial one of this power demonstration program, that they should look at it quickly—at least this is my understanding from reading the report—in order to furnish guidance for us for future contracts.

Representative COLE. In GAO's study of this Yankee contract, did its representatives discuss the project and its various facets with anybody in the Commission?

Mr. FIELDS. Yes, we had fairly—I was going to say extensive but I cannot vouch for this, but there were several conferences between our people and theirs on this contract.

Representative COLE. I assume some representative of the Commission must have pointed out to the GAO what to me is an apparent absurdity of requiring a guaranty of completion of a project on which you are going to spend millions of dollars to find out whether the thing will work or not.

Now, why was not the Commission successful in persuading the GAO of the reasonableness of the Commission's position?

Mr. FIELDS. I don't know how to answer that, Mr. Cole, except that I would say we have different segments of our operations in the Government and there is a tendency to overstate your own case a bit.

I have difficulties in my own organization where the controller takes one view that is very radical as opposed to the operating man that wants to get something done. They are looking at it a little bit perhaps too much where in the contract the Government should get everything out of it that it could rather than one that would help foster the development work.

Don't misunderstand me. I think the GAO comments will be very helpful to us and lay a good groundwork for the future.

Representative COLE. What will you do differently now?

Mr. FIELDS. There is this difference in my mind with them on this question of guaranties. I think we should seek assurances that their companies are going to see what they undertake through. When I say that, I don't mean building a reactor. It is what is described in the contract that we have assurance they are going to see it through until they hit a roadblock that stops them.

This is something short of a guaranty that they will build a reactor, come what may, and no matter how it looks. I think it will be helpful, Mr. Cole, to have this.

Senator PASTORE. Under this procedure, where we have the right to audit the money that they expend for research and development within the $4 million range, is it not your understanding that we have the right, or we would have the legal right, to suspend any furuther payments in the event they did not go forward with certain other matters that we thought might be necessary in the furtherance of this research and development?

Mr. FIELDS There are termination provisions in the contract.

Senator PASTORE. Let me make it more specific.

On page 4 you are talking about architecture and design. Let us assume that they did none of that and let us assume that they did not turn a spade of earth and let us assume they did not even buy a site.

Would we not have the authority to hold up on the $4 million and say, "Now, look, what are you doing about your end of this?" or do you think that has been written out in clear language to that effect before we could insist upon that?

Mr. FIELDS. I would have to think about that one a bit, sir. I am not sure.

Representative COLE. What difference would it make whether they bought any land or not, or whether they spent their money for engineering and architectural fees, as to whether you would be justified in going ahead spending your $4 million?

Mr. FIELDS. Let me make a statement to this effect at this point, sir. As I understand the expenditures at this stage, we have expended something like $600,000 on this contract and they have expended $400,000, and that these will go along roughly like this until January of next year when the Yankee expenditures will start to go straight up because of their construction commitments.

They will move way ahead of us in their expenditures about a year from now. We will be roughly a little bit ahead of them in the meantime. That is the way it stands insofar as the actual expenditures.

Now, I would think we would follow this. If they show signs they are not doing anything, but sitting back and thinking about this, I think we would take into consideration what to do, but I think it is unfortunate to impugn this group of companies who show every evidence that they are going to bring nuclear power to New England.

Senator PASTORE. I quite agree with you, but we are getting into the legal aspects of this guaranty we are talking about.

After all, you brought out the fact that we do not know whether or not this thing is going to be successful to begin with. That is the reason why we are spending this money for research and development.

But during the process of spending this $4 million, which I think we would have the right to spend as Mr. Cole said, do you feel that we would have such hold on this reimbursement element to say, "Look here, we keep spending ours, but you do nothing. How serious are you about this?"

Do you think somewhere along the line we have the right to give them the proper nudges to make sure that they are sincere?

Mr. FIELDS. I believe so, but I would like to ask the General Counsel if he has a different view.

Mr. MITCHELL. I think we do, Senator Pastore. As you suggest, there are obligations on the part of the company as well as ours. If they are obviously not complying with their commitments——

Senator PASTORE. This element of sincerity is rather amusing with me because I have had several talks with Mr. Webster, myself, and he was sitting on my doorstep for the longest time in order to get the AEC to act on this matter. That is the reason why I am rather confused about this question of sincerity, so much so that the whole matter was brought before the united delegation of New England Senators whereupon we took it upon ourselves to write you a letter to ask you to expeditiously make a decision.

Mr. FIELDS. All of this prodding, of course, came from these groups. I have no question in my own mind that these people are very sincere about this and will carry out their side of the bargain in a very businesslike, expeditious way.

Their steps to date have been very encouraging. They have two very good contractors doing excellent work in the progress of this.

I might say, Mr. Webster himself is really following this from a management standpoint.

I have been quite interested in the fact that he, himself, is applying the economic views to this thing and when a judgment has to be made, "Will we meet this power level or not," he will take somewhat of a risk maybe, maybe a 40 to 60 percent chance he can get that power level rather than spend an extra $2 million to make sure he might get just a little bit more.

The economic motive is coming in this to make it an economic powerplant.

The CHAIRMAN. Did the question ever arise between the AEC and Yankee as to whether or not the GAO had the authority to audit the accounts?

Mr. FIELDS. In the negotiations of the contract the Yankee Co. was quite reluctant to allow the rider that is on the contract, which gives the right to the GAO to audit any expenditures related to the contract. They were quite reluctant with respect to this.

We took it to the GAO and they said the contract would be open to question if this were not included and Yankee agreed to include it.

The CHAIRMAN. They made a ruling on that?

Mr. FIELDS. Yes, sir.

Representative COLE. What was the reason for the recommendation that Commission contracts contain that provision if it was already in the contract?

Mr. FIELDS. To give the AEC the right to audit as opposed to the GAO.

Representative COLE. The GAO recommends that the AEC reserve the right to audit. Rather than the GAO to audit, I notice that we both have the right.

Representative PATTERSON. At the outset I want to say I think it is a good contract. I notice in your statement, General, on page 2, under the terms of this contract you state the company agreed to construct a reactor with its own funds at capital cost of approximately $35 million.

Then you go on to say:

The company also agreed to operate the reactor at its own expense and the sponsoring companies agreed to purchase the electricity therefrom.

Now, in the General Accounting report, in the summary, there is a conflict of statements in my estimation:

The Yankee is a newly formed company which is wholly owned by 12 New England public utility companies. However, these companies have not yet executed binding agreements with Yankee covering their proposed capital contributions to Yankee and their purchase of power produced by Yankee.

Mr. FIELDS. It gets back to the word "binding," sir, and how you define that. Each of these boards of direction has passed resolutions that they intend to contribute a certain amount so that it adds up to this $18 million for the capitalization of this company when it is required for the capitalization.

They have similarly agreed that it is their intention that when this plant is operating that they will contract for that much power.

Now, the question is whether a board of directors action, and we have it that each of these boards of directors has taken this action, whether the expression by them of an intention is a firm commitment.

Representative PATTERSON. I think the action of the board of directors of any company or corporation when it really acts in committing the company is a binding contract.

Mr. FIELDS. That is the interpretation of whether the action they have taken today is yet binding. Presumably with a firmer cost estimate this summer which the Yankee Co. believes they will have on the basis of more detailed design, they will then have a fairly firm cost estimate upon which they would then get the companies to actually subscribe and take their stock as I understand it.

On that basis, they would then arrange interim financing for their senior securities at that time, depending upon the market.

That would be for the $35 million.

Now, it is a question of how much. There is a binding agreement to obtain that.

Does Yankee have to have the $18 million that they will subscribe to in its hand right now, or do they have to have in each of these companies their proportionate share marked off in their books and held in reserve for that purpose?

Senator PASTORE. You will admit that would have been a better thing, had that happened.

Representative PATTERSON. But it is still committed.

Senator PASTORE. At least it is a moral commitment.

Representative PATTERSON. I think the decision of the board of directors of any company, if they actually act on any statement, is a commitment in a business deal.

Senator PASTORE. I am not being critical of the GAO. I think, myself, they have the right, the authority, and the responsibility to construe these contracts in their strictest light. But here, of course, we are not financing a profitable enterprise. This is a research and development project at best.

When you begin to insist about guaranties, of course you are touching an area that is quite delicate. I do not know that if we began to take that attitude, that we could have this partnership between busi-

ness and Government. I am afraid if we got a little too insistent upon some of these things, that that would break down the real spirit of the 1954 law.

As a matter of fact, we would place ourselves in a position where the Government would have to do it all, let alone the research and development. We would have to actually go into the business of constructing these reactors, and whereby here you have the situation where the Government gambles $300,000 against $35 million on the part of private industry, in the same enterprise we would end up by having to do it all ourselves.

When you consider it in that perspective, I think it is a very, very good contract.

Mr. FIELDS. You understand, Senator, of that eight million three, three million three is not really a budgeted amount. It is a charge for the use of the material.

Senator PASTORE. And that will not come into being until such time as they have built the reactor.

Mr. FIELDS. Yes, sir.

Representative PATTERSON. General, with all the safeguards that you have in this contract, I think personally that the Government is going to do all right.

Now, in your opinion, do you feel that the Government is going to come out on top in this whole contract?

Mr. FIELDS. Is the Government going to do what, sir?

Representative PATTERSON. Is the Government going to come out on top in this whole deal?

Mr. FIELDS. I think this gives every indication of being a good arrangement for the Government that will result in an advanced pressurized water reactor which, knowing what you can do with it, will be of great value to this country, both domestically and foreign.

Representative PATTERSON. Under the agreements with the contractor, there cannot be any abuse on the part of private industry with respect to the Government?

Mr. FIELDS. No, sir; we have the right to follow it in detail so that there should not be any likelihood of that, sir.

Representative PATTERSON. I still think it is a very good contract.

The CHAIRMAN. General Fields, the right to audit under this procedure is to evaluate the economics, is it, during the life of the Yankee plant?

Do you have a cutoff date on this?

Mr. FIELDS. I will have to ask the Controller on that.

Mr. BURROWS. It is the period of the contract.

Mr. FIELDS. It runs for the period of the contract which would be after 5 years of operation.

The CHAIRMAN. Five years only.

Mr. FIELDS. Yes, sir.

The CHAIRMAN. We will not be involved in going beyond that because of the fact that we furnish the fuel?

Mr. FIELDS. I do not believe so, not under this present arrangement.

The CHAIRMAN. It is very good to have this thing out in the open because, in the future, I think we are going to be involved in a good deal more contract work somewhat similar to this.

Representative COLE. I am not clear what you are waiving when you speak of waiving the use charge.

Does that mean that the Yankee people will not pay for the burn-up.

Mr. FIELDS. They will pay for the burn-up of the material at $16,000 a kilogram.

Representative COLE. Why should there be any charge at all then if they are going to pay for what they use?

Mr. FIELDS. One of our charges established in the use of this material has been a 4-percent charge per year on the amount represented as the value of the material that is in the hands of the user. This would be true in the case of a 103 licensee.

We are required to charge that.

Representative COLE. That use charge there is more in the way of interest on the value rather than the material they actually use?

Mr. FIELDS. That is correct.

They would have to pay for the material that is burnt up. They ship their fuel rods back to us and we reprocess them and the difference, which is what is burned up, they will be billed for at $16,000.

Representative COLE. How did you arrive at 4 percent for the use charge?

Mr. FIELDS. I think it was arrived at somewhat arbitrarily, I would say. Maybe the Controller may answer that.

Mr. BURROWS. We took into consideration the cost to the Treasury of the money which is presumably put up to purchase this material at 3 percent. Then we more or less arbitrarily put on another percent to take care of our cost of handling.

Representative PRICE. General Fields, I just want to ask you this question: Could you explain to us the essential difference between this advanced type of pressurized water reactor as against the Shippingport reactor.

Mr. FIELDS. Perhaps I had better ask Dr. Davis. I know the main differences, I believe.

Mr. DAVIS. I think there are two principal differences, Mr. Price.

First of all, although about the same size plant physically, this has an output of about 134,000 net electrical kilowatts.

Second, it is planned to use a stainless-steel core of entirely different design than that in the PWR at Shippingport. So it will allow exploration of this type of core which we feel may be substantially cheaper, and also give us a higher output.

Representative PRICE. Does it increase its efficiency?

Mr. DAVIS. The thermal efficiency of the plant?

Representative PRICE. Yes: in its productive capacity.

Mr. DAVIS. I believe the thermal efficiency is about the same. In the terms of the dollars per kilowatt and operating cost, this efficiency will be considerable greater, of course.

Representative COLE. Would the Commission have authority to extend beyond 5 years this waiver of use charge?

Mr. FIELDS. Yes, according to the act.

Representative COLE. Of course, that is a considerable consideration to the Yankee people, that waiver of the use charge. But what does it mean to the Government? What would happen to this material if Yankee did not use it?

Mr. FIELDS. You have to consider all uses. If there were a dearth of uses, it would either be used in weapons or stockpile, I presume.

Representative COLE. And nobody would pay any use charge?

Mr. FIELDS. No one would pay any use charge.

Representative COLE. Is it not true that there is presently and for the near future a dearth of uses?

Mr. FIELDS. Commercial uses, you mean?

Representative COLE. Yes.

Mr. FIELDS. In large scale?

Representative COLE. Yes.

Mr. FIELDS. In the immediate future, with the number of reactors that are in prospect, it will take a considerable amount of material to charge them all when you get into the period of 1960 and beyond.

Representative COLE. My point is that while this does represent some substantial savings to Yankee, it does not represent a corresponding profit of gain to the United States Treasury, because this same material that is not used up in New England is going to be stored down in some storage house place and not be used by anybody?

Mr. FIELDS. That is correct.

Senator GORE. General Fields, I have read with some care the report of the General Accounting Office, and also your statement. I feel prompted to commend the GAO for the exercise of proper vigilance with respect to this Government contract.

I also feel quite sympathetic with the Commission and the companies involved in this contract, because I recognize that this field has not been developed to the point where inflexible black and white contractual warranties on the part of the companies, or perhaps even on the part of the Government itself, are feasible.

I find no term in the contract, no evidence in the GAO report, no evidence any place, of any lack of good faith in this contract.

Mr. FIELDS. I do not either, sir.

Senator GORE. I think the General Accounting Office is acting properly in exercising vigilance in this case. That is the purpose for which it is in existence. I do not place this transaction in the category of the Dixon-Yates contract; it is of an entirely different order.

With that preface, I do have 1 or 2 questions.

Is there yet a contract on the part of the sponsoring companies to take the electricity to be generated by the plant, and if so, at what price?

Mr. FIELDS. I would say there is not a contract. There is an action by each of the board of directors, who have stated their intention to take their proportionate share of the power that is produced, and it varies with the company.

Senator GORE. No price has yet been determined?

Mr. FIELDS. No price as yet determined.

Senator GORE. Does the Commission presume that electric power will be purchased by the sponsoring companies at a price comparable to the cost of generating electricity by conventional means in this area?

Mr. FIELDS. I presume it would be purchased at a price comparable to the cost of its generation.

Senator GORE. Of the cost of generating in that particular plant?

Mr. FIELDS. Yes; I believe so.

Do you have any different information?

Mr. DAVIS. So far as I know, they plan to sell the power to the companies at the cost of generation in the plant.

Senator GORE. Would you say that again?

Mr. DAVIS. So far as I know, it is the intention of Yankee to sell to the participating companies the power at the cost of generating it in the Yankee plant.

Senator GORE. So no subsidy is envisioned, insofar as the Commission is concerned, with respect to the price at which electricity is to be sold or purchased?

Mr. FIELDS. That is right.

Senator GORE. Is there a construction permit? Has a construction permit been issued?

Mr. FIELDS. No, sir. They have applied. There are some provisions that still have to be augmented. It is not at the moment ready for issuance. There are pieces of it that they still have to supply, as I understand it.

Senator GORE. Could you identify those pieces?

Mr. FIELDS. I cannot, personally.

Mr. PRICE. The Yankee Co. applied for their license sometime last summer. At that time, they had not furnished the complete study that the regulations required with respect to safety matters. They have been developing this safety study in recent months, and our latest information is that they expect to have it to us in a month or so.

Senator GORE. Then I gather it is correct to say, generally, that the requirements have not yet been fully met for the issuance of a construction permit.

Mr. PRICE. That is right, sir.

Senator GORE. Would you be qualified to give us the approximate construction schedule indicated thus far in their application for the permit?

Mr. PRICE. I do not have with me the completion dates that they gave us when they applied for their license, but I will be glad to supply it for the record. I just do not have it in mind. Maybe somebody else here may have it.

Senator GORE. Well, so long as you supply it for the record.

Mr. PRICE. Yes.

(The material referred to follows:)

The license application submitted by Yankee states that the company's schedule calls for the loading of the first core in the reactor during the second calendar quarter of 1960, with power operations scheduled for sometime in the fourth quarter of 1960.

Senator GORE. General, I have one more question.

Do you feel, and does the Commission feel, that the objections of the General Accounting Office can be satisfied to the extent that this contract can proceed without serious impairment?

Mr. FIELDS. I believe they can; yes, sir. Senator Gore, this needs some discussion as to what is a binding agreement. On the interpretation of this word "binding," I believe we had quite a colloquy before you entered on this point and this question of guaranties.

The CHAIRMAN. We do have a letter here from the Yankee people, who state that the construction at the site is presently scheduled to commence in the summer of this year for completion late in 1960.

General Fields, on this waiver of use charges, you have done that in other contracts, have you not?

Mr. FIELDS. This applies to all the second-round contractors.

The CHAIRMAN. It says:

The Yankee contract does not fully comply with this policy since it provides that AEC will waive its use charge without limitation for all special nuclear materials used during the contract period.

Would you comment on that?

Mr. FIELDS. They are speaking there that we should have a waiver that has a ceiling in terms of dollars on it, I believe.

Now, the difficulty with that is that we do not yet know the exact description of the fuel element; how much fuel goes in it per centimeter of length, what the processing history is, how much will go in the inventory, so we do not know how much fuel they will have in the reactor at one time.

We believe the control on the burn-up plus our technical cognizance of the project is such as to make them husband their use of nuclear material so that it is economic.

The CHAIRMAN. Any further questions?

Mr. FIELDS. The GAO were calling your attention to the waiver of this use charge, as I understand it. They made no recommendation with respect to that.

The CHAIRMAN. I do not say it was critical. They just raised the question in their report.

Senator GORE. Mr. Chairman, I have one other question.

Is there any particular reason why the sponsoring companies would not now be in a position to make firm contractual obligations for the purchase of the output of this plant?

Mr. FIELDS. I do not know of any.

Senator GORE. It may not be necessary, but I wondered why that was not a matter of contract.

Mr. FIELDS. It may be awaiting whether they come out exactly 134 kilowatts or they end up with 110,000 or 150,000. I do not know.

I will take this up with Mr. Webster.

Senator GORE. You referred to the resolution of the various boards of directors to buy this power.

Mr. FIELDS. Yes, sir.

Senator GORE. Was that for a given amount of power or a percentage of output?

Mr. FIELDS. Percentage of output, I believe.

Senator GORE. Then it would not appear material whether the output was 110,000 or 140,000?

Mr. FIELDS. That is correct; it would not, on second thought.

Senator GORE. Would you supply whatever information is available with respect to this point for the record?

Mr. FIELDS. Yes, sir.

(The information referred to follows:)

ATOMIC ENERGY COMMISSION,
Washington, D. C., April 8, 1957.

Mr. JAMES T. RAMEY,
Executive Director, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. RAMEY: Transmitted herewith for your information and appropriate disposition is a statement for the record of the 202 hearings which it is hoped will be responsive to the request made by Senator Gore at the session

of March 5, 1957, concerning the ultimate disposition of power produced from the Yankee atomic reactor.

Sincerely yours,

BRYAN F. LAPLANTE,
Special Assistant to the General Manager (Congressional).

Yankee is working on the problem of obtaining definitive contracts with the participating companies but does not consider the matter to be specifically urgent at this time. It is presently contemplated by Yankee that the sponsoring, or participating, companies will share in the power to be generated, in the same proportion as their respective contributions to the cost of construction.

One of the obstacles standing in the way of reaching definitive agreements is the fact that the cost of power is not definitely known. Another difficulty lies in the requirement that all of the agreements will require approval by several State public utilities commissions. Also, the agreements must conform to the contracting policies of the various companies involved.

Yankee is working on a contract form which it hopes will be acceptable to all interested parties. Reaching agreement with respect to this form is likely to require considerable time.

Senator GORE. Thank you, General. I want to say I think you are doing a very excellent job.

Mr. FIELDS. Thank you.

Representative COLE. It seems to me the point that Senator Gore has just brought out is a rather important element of the Yankee deal; that, having constructed the reactor, it be put into operation. If the constituent corporations are not committed to buy the power and none of them do buy it, then the reactor is going to stand idle. If it stands idle, then the Government will lose the benefit that it seeks to gain by way of learning what the cost of operating the plant will be.

Mr. FIELDS. Yes.

Representative COLE. I think that point could be very important.

Mr. FIELDS. They have stated their intentions. I think that we will find that they may be surprised that anyone is suspecting that they do not have a firm belief in their mind that they are going to carry it through.

Senator GORE. I did not mean it in that respect. I was trying to inquire into just what these matters are which are not under firm contract. I am in full sympathy with the lack of firm contractual warranties where there is reason for it. On the surface, I could not imagine a reason why the companies could not now contract to accept and purchase the power from this plant because it would be such a small percentage of the electricity they use in their systems.

It was not on the matter of suspicion that I was inquiring at all. I assume they do have firm intentions, but the lack of contractual obligations was the crux of the GAO criticism.

Mr. FIELDS. That is correct.

Representative COLE. It was in that light I was making inquiry.

The CHAIRMAN. General Fields, I also congratulate you on your alertness on these contracts. I also want to congratulate the GAO on its alertness on these contracts. We should work together in harmony and peace to carry forward the atomic-energy program on such a basis.

Mr. FIELDS. Mr. Chairman, the more arguments I have with them before writing a contract, the better it is. As far as I know, the relationships with them have been excellent.

The CHAIRMAN. Without objection, I will include in the record a copy of the Yankee contract, the Comptroller General's ruling, and also his report on the contract, and a copy of the AEC correspondence regarding the GAO report.

I would also like to include in the record, without objection, several more statements from different manufacturers throughout the country, and correspondence between the Joint Committee and the AEC regarding certain recommendations of the McKinney panel on technical information and other matters.

(The material referred to follows:)

CONTRACT NO. AT(30-3)-222. YANKEE ATOMIC ELECTRIC COMPANY

This contract, entered into this 4th day of June 1956, by and between the United States of America (hereinafter called the Government), acting through the United States Atomic Energy Commission (hereinafter called the Commission), and the Yankee Atomic Electric Company, a corporation organized and existing under the laws of the Commonwealth of Massachusetts, and having its offices at 441 Stuart Street, Boston, Massachusetts (hereinafter called the Contractor),

Witnesseth that:

Whereas it is an announced policy of the Commission to encourage private participation in the development and demonstration of economically feasible nuclear power; and

Whereas the Contractor has proposed to assume all capital costs as well as other costs incident to the construction and operation of a nuclear powerplant, which it will own; and

Whereas the Commission is willing to render certain financial and other assistance to the Contractor in order to effectuate the necessary research and development effort leading to the design, construction, and operation of said nuclear powerplant as well as future assistance by waiving certain of its established charges; and

Whereas it is anticipated by the parties to this contract that the design, development, construction, and operation of the aforesaid nuclear powerplant will constitute a significant advance toward the demonstration of the practical value of nuclear power and that the information and experience so gained will lead to further technical advances in subsequent power reactors; and

Whereas the parties have agreed that the Contractor shall accomplish the work and perform the services necessary to place into operation such a powerplant, under the terms and conditions hereinafter recited; and

Whereas this contract is authorized by, and has been negotiated under, the Atomic Energy Act of 1954:

Now, therefore, the parties hereto do mutually agree as follows:

ARTICLE I. UNDERTAKINGS OF THE PARTIES

1. The Contractor shall, as expeditiously as may be practicable, accomplish the undertakings hereinafter set forth:

(*a*) The Contractor shall construct and operate a nuclear powerplant to be located near Rowe, Massachusetts, which will be powered initially by a pressurized water type of nuclear reactor, utilizing slightly enriched uranium oxide, stainless steel clad, fuel elements, and having an estimated net electrical generating capacity of one hundred thirty-four thousand (134,000) kilowatts, and bear all capital and operating costs in connection therewith.

(*b*) The Contractor shall perform and have performed such design, research, and development work as may be necessary to determine the best practicable design for the powerplant described in paragraph 1 (*a*) above; provided, however, that work performed hereunder, for which the Contractor is entitled to be reimbursed under the terms of this contract, shall be subject to the approvals and limitations prescribed elsewhere in this contract.

(*c*) The Contractor shall complete the work required by paragraph (*b*) of this Section 1, without reimbursement by the Government, if and to the extent that the cost of such work exceeds the maximum amount of the Government's obligation under Section 2 of Article III.

(*d*) The Contractor shall obtain all necessary licenses from the Commission and all other necessary approvals from Federal, State, and local regulatory authorities as are required to permit the construction and operation of the plant and the sale or use of the energy produced therein. It is understood that the execution of this agreement does not constitute a

representation by the Commission or the Government that any of the necessary licenses or approvals are or will be granted.

(*e*) The Contractor shall, whether the work is performed by it or its subcontractors, keep or cause to be kept records of technical and economic data developed in connection with the overall project and shall supply the Commission with information thereon. The Commission shall have the right to inspect the work and activities of the Contractor under this contract at such time and in such manner as it shall deem appropriate.

(*f*) During the development, design, and construction phases of the project, the Contractor shall submit reports, at such times, in such form, and containing such technical, economic, and progress information as the Commission may request. During the operation of the project, the Contractor shall submit reports, at such times, in such form, and containing such technical, economic, and operating data as the Commission may request. The Commission will consult with the Contractor with respect to the form, content, and frequency of such reports. It is understood that, by mutual agreement of the parties, arrangements may be made for the reporting of other data to the Commission. The Commission may use said data and reports as it may deem necessary or desirable and may disseminate or distribute said data and reports for use by others.

(*g*) The Contractor shall exert its best efforts, during the research and developmental stages of this contract, to avoid undertaking work which will duplicate work previously performed or currently being performed by others in the development of pressurized water type reactors, the results of which are available to the Contractor. The Commission will use its best efforts to make such information available to the Contractor during the course of the work.

2. The Commission will perform the undertakings hereinafter set forth:

(*a*) The Commission will have the work described in Appendix A performed in Commission facilities, subject to the limitations prescribed by Article III of this contract. The Commission shall use its best efforts to have this work performed at such time or times as will meet the Contractor's planned schedule. It is recognized that privately owned facilities may be developed during the term of this contract which are suitable for the performance of some phases of the work described in this paragraph and that the parties may by mutual agreement reschedule such work for performance in such privately owned facilities.

(*b*) The Commission will, subject to the limitations prescribed by Article III of this contract, bear the actual cost of the research and development work, described in Appendix B, which will be performed by, or under the supervision of, the Contractor in other than Commission facilities.

(*c*) The Commission hereby agrees to waive its use charge for the term of the contract for all special nuclear material used by the Contractor or by others in its behalf in carrying out the undertakings in paragraphs 1, a, and 1, b, of this Article I.

(*d*) The Commission agrees that, if requested by the Contractor, it will accept and reprocess or otherwise dispose of the Contractor's spent fuel elements in accordance with prevailing Commission policy as announced from time to time.

ARTICLE II. TERM OF CONTRACT

The term of this contract shall commence on the date of its execution and shall end five years after issuance of a license to operate the facility.

ARTICLE III. COST OF THE WORK

1. For the work performed by the Commission under paragraph 2, a, of Article I, the Commission will bear the actual costs and expenses which are incurred in the performance of such work and which are necessary or incident thereto; provided, however, that in no event will the Commission be obligated to incur costs in excess of One million dollars ($1,000,000.00) for work performed under this provision. If any item of work is in progress when aggregate costs under this provision have equalled One million dollars ($1,000,000.00), the Commission will use its best efforts to continue such work for such further time as may be necessary to obtain the experimental results for which the work was planned, and in that event the Contractor shall pay for the cost of such work to the extent

that it exceeds One million dollars ($1,000,000.00); provided, that such additional work has been approved in writing in advance by the Contractor. In determining the cost of this work, including direct and indirect costs, the Commission will employ its established policy of full-cost recover for pricing work performed for private sponsors in its Government-owned facilities.

2. For the work to be performed by the Contractor under paragraph 1, b, of Article I, and described in Appendix B, the Contractor shall be reimbursed in the manner hereinafter provided for costs incurred under subcontracts entered into in the performance of the work under said paragraph; provided, however, that the Contractor shall not be reimbursed for work performed hereunder which the Contracting Officer determines, in advance of its performance, would duplicate existing research and development effort or heretofore accomplished objectives in reactor technology. The Contractor shall submit in writing full descriptions of proposed research and development programs. The Contractor shall also be entitled to reimbursement for the salaries, excluding fringe benefits, of the Contractor's scientific, technical, and engineering personnel directly engaged in the performance of said work. All other costs and expenses shall be deemed unallowable. The Commission shall not be obligated to reimburse the Contractor for costs which in the aggregate exceed Four million dollars ($4,000,000.00), for said work. During the performance of said work, the Contractor shall take and afford the Government the advantage of all available cash and trade discounts, rebates, allowances, credits, salvage, commissions, and bonifications.

ARTICLE IV. OBLIGATION OF FUNDS; PAYMENTS

1. The amount of funds obligated by the Commission for the performance of the work described in paragraph 1, b, of Article I, for which the Contractor is entitled to reimbursement, is Four million dollars ($4,000,000.00).

2. The amount of funds obligated by the Commission for the purpose of paying costs and expenses incurred by the Commission and its other contractors in the performance of work in Commission facilities under paragraph 2, a, of Article I, is One million dollars ($1,000,000.00).

3. To the extent that the Contractor is entitled to reimbursement for allowable costs in accordance with the provisions of Article III, payment shall be made once each month, or at such other intervals as the parties may agree, upon submission by the Contractor to the Commission of certified invoices supported by such other documents as the Commission may require. Payments made under the provisions of this section shall be subject to subsequent audit and adjustment. The Commission may cause to be withheld all or any part of the final reimbursement payment until receipt of the final report, property accounting, patent disclosures required by this contract, a release in such form and with such exceptions as may be approved by the Commission, of all claims against the Government under or arising out of this contract (such release not to affect the Commission's continuing obligations under paragraphs 2, c, and 2, d, of Article I), and an assignment of the Contractor's rights to any refunds, rebates, allowances, accounts receivable, and other credits applicable to expenditures reimbursed under this contract.

ARTICLE V. TERMINATION

1. This contract may be terminated at any time by written agreement of the parties. Any such termination shall be effective in the manner and upon the date specified in said agreement.

2. The Contractor may terminate this contract at any time by written notice to the Commission if construction and operation of the plant is made impossible by is inability to obtain necessary licenses or regulatory agency approvals, or by its inability to obtain satisfactory liability insurance coverage.

3. Neither the Government nor the Contractor shall be required to reimburse the other or pay directly for any costs or expenses by reason of the termination of this contract by either party, other than for costs and expenses which have previously been incurred by the Contractor and for which it is entitled to reimbursement under the provisions of this contract.

ARTICLE VI. SUBCONTRACTS AND PURCHASE ORDERS

1. The Contractor may enter into subcontracts for the performance of any part of the work under this contract. Except as otherwise authorized by the

Contracting Officer, all such subcontracts shall be subject to the approval of the Contracting Officer.

2. The Commission reserves the right to require that the Contractor submit any or all other contractual arrangements, made in furtherance of the work hereunder, including but not limited to purchase orders or classes of purchase orders, for approval, and provide information concerning methods, practices and procedures used or proposed to be used in subcontracting and purchasing. The Contractor shall use methods, practices, and procedures in subcontracting and purchasing which are acceptable to the Commission. Subcontracts and purchase orders shall be made in the name of the Contractor, shall not bind nor purport to bind the Government, shall not relieve the Contractor of any obligation under this contract (including, among other things, the obligation properly to supervise and coordinate the work of subcontractors) and shall be in such form and contain such provisions as are required by this contract or as the Contracting Officer may prescribe.

ARTICLE VII. PROPERTY

1. The Government reserves the right to furnish any property or services required for the performance of the work under this contract.

2. Title to all property furnished by the Government shall remain in the Government except as otherwise provided in this article. Except as otherwise provided by the Contracting Officer, title to all materials, equipment, supplies and tangible personal property of every kind and description purchased by the Contractor, for the cost of which the Contractor is entitled to be reimbursed as a direct item of cost under this contract, shall pass directly from the vendor to the Government. The Government reserves the right to inspect, and to accept or reject, any item of such property. The Contractor shall make such disposition of rejected items as the Contracting Officer shall direct. Title to other property, the cost of which is reimbursable to the Contractor under this contract, shall pass to and vest in the Government upon (*a*) issuance for use of such property in the performance of this contract or (*b*) commencement of processing or use of such property in the performance of this contract, or (*c*) reimbursement of the cost thereof by the Government whichever first occurs. Property furnished by the Government and property purchased or furnished by the Contractor title to which vests in the Government under this section are hereinafter referred to as Government Property. Title to Government Property shall not be affected by the incorporation of the property into or the attachment of it to any property not owned by the Government, nor shall such Government Property, or any part thereof, be or become a fixture or lose its identity as personalty by reason of affixation to any realty.

3. To the extent directed by the Contracting Officer, the Contractor shall identify Government Property coming into the Contractor's possession or custody by marking or segregation in such a way, satisfactory to the Contracting Officer, as shall indicate its ownership by the Government.

4. The Contractor shall make such disposition of Government Property which has come into the possession or custody of the Contractor under this contract as the Contracting Officer shall direct. When authorized in writing by the Contracting Officer during the progress of the work or upon completion or termination of this contract, the Contractor may, upon such terms and conditions as the Contracting Officer may approve, sell or exchange such property, or acquire such property at a price agreed upon by the Contracting Officer and the Contractor as the fair value thereof. The amount received by the Contractor as the result of any disposition, or the amount of the agreed fair value of any such property acquired by the Contractor, shall be applied in reduction of costs allowable under this contract, or shall be otherwise credited to account of the Government, as the Contracting Officer may direct. Upon completion of the work or the termination of this contract the Contractor shall render an accounting, as prescribed by the Contracting Officer, of all Government Property which has come into the possession or custody of the Contractor under this contract.

5. The Contractor shall take all reasonable precautions, as directed by the Contracting Officer, or in the absence of such directions in accordance with sound industrial practice, to safeguard and protect Government Property in the Contractor's possession or custody. Special measures shall be taken by the Contractor in the protection of and accounting for any classified or special materials involved in the performance of this contract, in accordance with the regulations and requirements of the Commission.

6. The Contractor shall not be liable for loss or destruction of or damage to Government Property in the Contractor's possession unless such loss, destruction or damage results from wilful misconduct or lack of good faith on the part of the Contractor's managerial personnel, or unless such loss, destruction or damage results from a failure on the part of the Contractor's managerial personnel, to take all reasonable steps to comply with any appropriate written directives of the Contracting Officer to safeguard such property under Section 5, hereof. The term "Contractor's managerial personnel" as used herein means the Contractor's directors, officers and any of its managers, superintendents, or other equivalent representatives who have supervision or direction of (*a*) all or substantially all of the Contractor's business; or (*b*) all or substantially all of the Contractor's operation at any one plant or separate location at which this contract is being performed; or (*c*) a separate and complete major industrial operation in connection with the performance of this contract; or (*d*) a separate and complete major construction, alteration or repair operation in connection with performance of this contract.

7. Upon the happening of any loss or destruction of or damage to Government Property in the possession or custody of the Contractor the Contractor shall immediately inform the Contracting Officer of the occasion and extent thereof, shall take all reasonable steps to protect the property remaining, and shall repair or replace the lost, destroyed, or damaged property if and as directed by the Contracting Officer, but shall take no action prejudicial to the right of the Government to recover therefor and shall furnish to the Government on request all reasonable assistance in obtaining recovery.

8. Except as the Contracting Officer shall otherwise authorize, Government Property shall be used only for the performance of work under this contract.

ARTICLE VIII. INVENTIONS

1. Whenever any invention or discovery is made or conceived by the Contractor or its employees in the course of, or in connection with, the work paid for by the Commission or performed at a Commission facility or utilizing the services of the Commission or Commisison contractor personnel, the Contractor shall furnish the Commission with complete information thereon; and the Commission shall have the sole power to determine whether or not and where a patent application shall be filed, and to determine the disposition of the title to and the rights under any application or patent that may result; provided, however, that the Contractor, in any event, shall retain at least a nonexclusive, irrevocable, royalty-free license under said invention, discovery, application, or patent. Subject to the license retained by the Contractor, as provided in this section, the judgment of the Commission on these matters shall be accepted as final; and the Contractor, for itself and its employees, agrees that the inventor or inventors will execute all documents and do all things necessary or proper to carry out the judgment of the Commission.

2. Whenever any invention or discovery is made or conceived by or for the Contractor or its employees in research and development in the course of, in connection with, or under this agreement, other than as provided for in Section 1, hereof, the Contractor shall promptly furnish the Commission with complete information thereon and shall specify at the time of such disclosure whether or not the Contractor desires to file a patent application, subject to security restrictions and requirements. The Contractor agrees to and hereby grants a nonexclusive, irrevocable, royalty-free license to the Government for governmental purposes under said invention, discovery, application, or patent; provided, however, that if the Contractor advises that it does not desire to file a patent application, the Commission may file such application, in which event the rights under said invention, discovery, application, or patent shall be determined in accordance with Section 1, hereof.

3. No claim for pecuniary award or compensation under the provisions of the Atomic Energy Act of 1954 shall be asserted by the Contractor or its employees with respect to any invention or discovery made or conceived in the course of, in connection with, or under the terms of this agreement.

4. Except as otherwise authorized in writings by the Commission, the Contractor will obtain patent agreements to effectuate the purposes of Sections 1, 2, and 3 of this article from all persons who perform any part of the work under this agreement, except such clerical and manual labor personnel as will not have access to technical data.

5. The Contractor agrees that it will insert in all subcontracts hereunder, the costs of which are reimbursable hereunder, and all subcontracts involving the performance of research or development work in the course of, in connection with, or under this agreement, provisions relating to inventions and discoveries which are authorized or approved by the Commission.

6. The Contractor agrees that it will insert in all purchase orders and other contractual arrangements for the procurement of standard commercial articles clauses acceptable to the Commission, indemnifying the Contractor and the Government against claims for patent infringement.

ARTICLE IX. STATE AND LOCAL TAXES

1. The Contractor agrees to notify the Contracting Officer of any State or local tax, fee, or charge levied or purported to be levied on or collected from the Contractor with respect to the contract work or any transaction thereunder and constituting an allowable item of cost if due and payable, and which, in the opinion of the Contractor or under the position of the Commission as communicated to the Contractor, is inapplicable or invalid; and the Contractor further agrees to refrain from paying any such tax, fee, or charge unless authorized by the Contracting Officer. Any State or local tax, fee, or charge paid with the approval of the Contracting Officer or on the basis of advice from the Contracting Officer that such tax, fee, or charge is applicable and valid, and which would otherwise be an allowable item of cost, shall not be disallowed as an item of cost by reason of any subsequent ruling or determination that such tax, fee, or charge was in fact inapplicable or invalid.

2. The Contractor agrees to take such action as may be required or approved by the Contracting Officer to cause any such tax, fee, or charge referred to above to be paid under protest, and to take such actions as may be required or approved by the Contracting Officer to seek recovery of any payment made, including assignment to the Government or its designee, of all rights to an abatement or refund thereof, and granting permission for the Government to join with the Contractor in any proceedings for the recovery thereof or to sue for recovery in the name of the Contactor. If the Contracting Officer directs the Contractor to institute litigation to enjoin the collection of or to recover payment of any such tax, fee, or charge referred to above, or, if a claim or suit is filed against the Contractor for a tax, fee, or charge he has refrained from paying in accordance with this article, the costs and expenses incurred by the Contractor shall be allowable items or cost, as provided in this contract, together with the amount of any judgment rendered against the Contractor.

3. The Government shall save the Contractor harmless from penalties and interest incurred through compliance with this article.

ARTICLE X. ACCOUNTS, RECORDS, AND INSPECTION

1. The Contractor shall maintain accounts showing and supporting all allowable costs incurred, revenues earned, and the receipt, use, and disposition of all Government Property coming into the possession of the Contractor under this contract. The system of accounts employed by the Contractor for these purposes shall be satisfactory to the Commission and in accordance with generally accepted accounting principles.

2. All books of account and records relating to this contract shall be subject to inspection and audit by the Commission at all reasonable times, and the Contractor shall afford the Commission proper facilities for such inspection and audit.

3. The Contractor also agrees, with respect to any subcontracts (including lump-sum or unit-price subcontracts) where under the terms of the subcontract, costs incurred are a factor in determining the amount payable to the subcontractor of any tier, that it will on request of the Contracting Officer, conduct an audit of the costs of the subcontract in a manner satisfactory to the Commission or have the audit conducted by the next higher tier subcontractor in a manner satisfactory to the Contractor and the Commission.

4. Except as otherwise directed by the Contracting Officer or agreed upon by the Government and the Contractor, all financial and cost reports, books of account and supporting documents, and other data evidencing costs allowable and revenues accrued under this contract in the possession of the Contractor relating to this contract, shall be preserved by the Contractor for a period of six (6) years after final settlement of the contract, or otherwise disposed of in such manner as may be agreed upon by the Government and the Contractor.

5. The Contractor shall furnish such progress reports and schedules, financial and cost reports, and other reports concerning the work under this contract as the Commission may from time to time require.

6. The Contractor further agrees to require the inclusion of provisions similar to those in Sections 1 through 5 of this article in all subcontracts of any tier negotiated hereunder (including lump-sum or unit-price subcontracts), where, under the terms of the subcontract, costs incurred are a factor in determining the amount payable to the subcontractor.

ARTICLE XI. DRAWINGS, DESIGNS, SPECIFICATIONS

All drawings, sketches, designs, design data, specifications, notebooks, technical and scientific data, and all photographs, negatives, reports, findings, recommendations, data, and memoranda of every description relating thereto, as well as all copies of the foregoing, relating to the work or any part thereof, shall be subject to inspection by the Commission at all reasonable times, and the Contractor and its subcontractors shall afford the Commission proper facilities for such inspection, and, further, shall be the property of the Government and shall be delivered to the Government, or otherwise disposed of by the Contractor either as the Contracting Officer may from time to time direct during the progress of the work or in any event as the Contracting Officer shall direct upon completion or termination of this contract; provided, however, that the Contractor may retain for its own use copies of any such documents and other material, subject to security regulations and requirements of the Commission.

ARTICLE XII. LABOR

1. In connection with the performance of work under this contract the Contractor shall not employ any person undergoing sentence of imprisonment at hard labor.

2. Whenever an actual or potential labor dispute is delaying or threatens to delay the performance of the work, the Contractor shall immediately notify the Contracting Officer in writing. Such notice shall include all relevant information concerning the dispute and its background.

3. No laborer or mechanic doing any part of the work contemplated by this contract, in the employ of the Contractor or any subcontractor contracting for any part of said work contemplated, shall be required or permitted to work more than eight hours in any one calendar day upon such work, except upon the condition that compensation is paid to such laborer or mechanic in accordance with the provisions of this article. The wages of every laborer and mechanic employed by the Contractor or any subcontractor engaged in the performance of this contract shall be computed on a basic day rate of eight hours per day and work in excess of eight hours per day is permitted only upon the condition that every such laborer and mechanic shall be compensated for all hours worked in excess of eight hours per day at not less than one and one-half times the basic rate of pay. For each violation of the requirements of this article a penalty of five dollars shall be imposed for each laborer or mechanic for every calendar day in which such employee is required or permitted to labor more than eight hours upon said work without receiving compensation computed in accordance with this article, and all penalties thus imposed shall be withheld for the use and benefit of the Government: *Provided*, That this stipulation shall be subject in all respects to the exceptions and provisions of the Eight-Hour Laws as set forth in 40 U. S. C. 321, 324, 325a, and 326, which relate to hours of labor and compensation for overtime.

4. In connection with the performance of work under this contract, the Contractor agrees not to discriminate against any employee or applicant for employment because of race, religion, color, or national origin. The aforesaid provision shall include but not be limited to the following: employment, upgrading, demotion, or transfer, recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post hereafter in conspicuous places, available for employees and applicants for employment, notices to be provided by the Contracting Officer setting forth the provisions of the nondiscrimination clause. The Contractor further agrees to insert the foregoing provision in all subcontracts hereunder, except subcontracts for standard commercial supplies or raw materials.

ARTICLE XIII. DOMESTIC PREFERENCE

The Contractor agrees that in the performance of the work under this contract, the Contractor, subcontractors, material men, and suppliers shall use only such unmanufactured articles, materials, and supplies (which term "articles, materials, and supplies" is hereinafter referred to in this article as "supplies") as have been mined or produced in the United States, and only such manufactured supplies as have been manufactured in the United States substantially all from supplies mined, produced, or manufactured, as the case may be, in the United States. The foregoing provisions shall not apply (*a*) with respect to supplies exempted by the Commission from the application of the Buy American Act (41 U. S. C. 10a–d); (*b*) with respect to supplies for use outside the United States; or (*c*) with respect to the supplies to be used in the performance of work under this contract which are of a class or kind determined by the Commission not to be mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality; or (*d*) with respect to such supplies, from which the supplies to be used in the performance of work under this contract are manufactured, as are of a class of kind determined by the Commission not to be mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality, provided tht this exception (*d*) shall not permit the use in the performance of work under this contract of supplies manufactured outside the United States if such supplies are manufactured in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality.

ARTICLE XIV. SECURITY

1. In the performance of the work under this contract the Contractor shall, in accordance with the Commission's security regulations and requirements, be responsible for safeguarding restricted data and other classified matter and protecting against sabotage, espionage, loss and theft, the classified documents, materials, equipment, processes, etc., as well as such other material of high intrinsic or strategic value as may be in the Contractor's possession in connection with performance of work under this contract. Except as otherwise expressly authorized by the Commission, the Contractor shall, upon completion or termination of this contract, transmit to the Commission any classified matter in the possession of the Contractor or any person under the Contractor's control in connection with performance of this contract.

2. The Contractor agrees to conform to all security regulations and requirements of the Commission.

3. The term "Restricted Data," as used in this article, means all data concerning (*a*) design, manufacture, or utilization of atomic weapons; (*b*) the production of special nuclear material; or (*c*) the use of special nuclear material in the production of energy, but shall not include data declassified or removed from the Restricted Data category pursuant to Section 142 of the Atomic Energy Act of 1954.

4. Except as the Commission may authorize, in accordance with the Atomic Energy Act of 1954, the Contractor shall not permit any individual to have access to Restricted Data until the designated investigating agency shall have made an investigation and report to the Commission on the character, associations, and loyalty of such individual and the Commission shall have determined that permitting such person to have access to Restricted Data will not endanger the common defense and security. As used in this section, the term "designated investigating agency" means the United States Civil Service Commission or the Federal Bureau of Investigation, or both, as determined pursuant to the provisions of the Atomic Energy Act of 1954.

5. It is understood that disclosure of information relating to the work or services ordered hereunder to any person not entitled to receive it, or failure to safeguard any Restricted Data or any top secret, secret, or confidential matter that may come to the Contractor or any person under the Contractor's control in connection with work under this contract, may subject the Contractor, his agents, employees, and subcontractors to criminal liability under the laws of the United States. (See the Atomic Energy Act of 1954, 68 Stat. 919. See also Executive Order 10104 of February 1, 1950, 15 F. R. 597.)

6. Except as otherwise authorized in writing by the Contracting Officer, the Contractor shall insert provisions similar to the foregoing in all subcontracts and purchase orders under this contract.

ARTICLE XV. SAFETY, HEALTH, AND FIRE PROTECTION

The Contractor shall take all reasonable precautions in the performance of the work under this contract to protect the health and safety of employees and of members of the public and to minimize danger from all hazards to life and property, and shall comply with all health, safety, and fire protection regulations and requirements (including reporting requirements) of the Commission. In the event that the Contractor fails to comply with said regulations or requirements of the Commission, the Contracting Officer may, without prejudice to any other legal contractual rights of the Commission, issue an order stopping all or any part of the work; thereafter a start order for resumption of work may be issued at the discretion of the Contracting Officer. The Contractor shall make no claim for an extension of time or for compensation or damages by reason of or in connection with such work stoppage.

ARTICLE XVI. EXAMINATION OF RECORDS

1. The Contractor agrees that the Comptroller General of the United States or any of his duly authorized representatives shall have access to and the right to examine any directly pertinent books, documents, papers, and records of the Contractor involving transactions related to this contract until the expiration of three years after final payment under this contract unless the Commission authorizes their prior disposition.

2. The Contractor further agrees to include in all its subcontracts hereunder a provision to the effect that the subcontractor agrees that the Comptroller General of the United States or any of his duly authorized representatives shall have access to and the right to examine any directly pertinent books, documents, papers, and records of such subcontractor involving transactions related to the subcontract until the expiration of three years after final payment under this contract unless the Commission authorizes their prior disposition. The term "subcontract" as used herein means any purchase order or agreement to perform all or any part of the work or to make or furnish any materials required for the performance of this contract, but does not include (*a*) purchase orders not exceeding $1,000, (*b*) subcontracts or purchase orders for public utility services at rates established for uniform applicability to the general public, or (*c*) subcontracts or purchase orders for general inventory items not specifically identifiable with the work under this contract.

3. Nothing in this contract shall be deemed to preclude an audit by the General Accounting Office of any transaction under this contract.

ARTICLE XVII. DISPUTES

Except as otherwise provided in this contract, any dispute concerning a question of fact arising under this contract which is not disposed of by agreement shall be decided by the Contracting Officer, who shall reduce his decision to writing, and mail or otherwise furnish a copy thereof to the Contractor. Within 30 days from the date of receipt of such copy, the Contractor may appeal by mailing or otherwise furnishing to the Contracting Officer a written appeal addressed to the Commission, and the decision of the Commission shall, unless determined by a court of competent jurisdiction to have been fraudulent, arbitrary, capricious, or so grossly erroneous as necessarily to imply bad faith, or is not supported by substantial evidence, be final and conclusive; *provided*, that if no such appeal to the Commission is taken, the decision of the Contracting Officer shall be final and conclusive. In connection with any appeal proceeding under this article, the Contractor shall be afforded an opportunity to be heard and to offer evidence in support of its appeal. Pending final decision of a dispute hereunder, the Contractor shall proceed diligently with the performance of the contract in accordance with the Contracting Officer's decision.

ARTICLE XVIII. ASSIGNMENT

Neither this contract nor interest nor claim thereunder shall be assigned or transferred by the Contractor, except as expressly authorized in writing by the Contracting Officer.

ARTICLE XIX. COVENANT AGAINST CONTINGENT FEES

1. The Contractor warrants that no person or selling agency has been employed or retained to solicit or secure this contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Contractor for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this contract without liability or in its discretion to deduct from the contract price or consideration the full amount of such commission, percentage, brokerage, or contingent fee.

2. Unless otherwise authorized by the Contracting Officer in writing the Contractor shall cause provisions similar to the foregoing to be inserted in all subcontracts and purchase orders entered into under this contract.

ARTICLE XX. OFFICIALS NOT TO BENEFIT

No member of or delegate to Congress, or Resident Commissioner, shall be admitted to any share or part of this contract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this conract if made with a corporation for its general benefit.

ARTICLE XXI. RENEGOTIATION

1. This contract is subject to the Renegotiation Act of 1951, as amended, and shall be deemed to contain all the provisions required by Section 104 of said Act.

2. The Contractor agrees to insert the provisions of this article, including this Section 2, in all subcontracts specified in Section 103 (g) of the Renegotiation Act of 1951: *Provided*, That the Contractor shall not be required to insert the provisions of this article in any subcontract exempted by or pursuant to Section 106 of the Renegotiation Act of 1951, as amended.

ARTICLE XXII. MODIFICATION

This contract may be modified by written agreement of the parties. Any such modification shall be effective in the manner and upon the date specified in said agreement. Without limiting the generality of the foregoing, it is recognized that this contract may be so modified to provide for a different reactor type or design (i) in the event that advances in reactor technology make outmoded the use of a reactor of the type described in paragraph 1, a, of Article I as an approach to economically competitive nuclear power, or (ii) in the event that estimated power costs substantially exceed the original estimates upon which the Contractor's modified proposal under the Power Demonstration Reactor Program, dated August 22, 1955, was based.

ARTICLE XXIII. OPTION TO PURCHASE

1. If at any time after the construction of the reactor portion of the powerplant is initiated the Contractor fails to continue with the construction or operation, regardless of the reason for such failure, the Commission shall have the right and option to purchase the reactor plant and related facilities owned by the Contractor. For the purposes of this article "related facilities" shall not be construed to include the power-generating plant and equipment erected by the Contractor. Upon written notification from the Contractor that it will not continue with the construction or operation of the plant, the Commission shall, within six months after receipt of such notification, inform the Contractor in writing whether or not the Commission desires to exercise its option to purchase the reactor plant and related facilities from the Contractor; provided, however, that in computing such six months' period there shall be excluded any period during which either House of the Congress of the United States is not in session by reason of an adjournment of more than three days. In the event that this purchase option is exercised by the Commission, the Contractor will then sell to

the Commission the reactor plant and related facilities, together with all parts, components, and equipment in their then existing status and condition and the real estate and related rights, including necessary water rights and rights of access, adequate for the Commission's intended operation.

2. The property and rights to be sold to the Commission, and the price to be paid therefor will be mutually agreed upon by the parties. If the parties are unable to agree, such disagreement shall be considered a dispute concerning a question of fact within the provisions of Article XVII (notwithstanding the provisions of Article XXIV) but in no event will such price exceed the original acquisition, engineering, fabrication, or construction cost, less depreciation, of particular items of equipment, supplies, and other tangible property, and will not include research, development, or other costs incurred in anticipation of such fabrication, engineering, construction, or acquisition of tangible property.

ARTICLE XXIV. APPLICABILITY OF ARTICLES

Articles VI, VII, IX, X, XI, XII, XIII, XIV, XV, XVII, and XXI shall apply only to work performed pursuant to paragraph 1, b, of Article I, and described in Appendix B: *Provided, however,* That nothing herein shall be construed to limit or otherwise affect the provisions or effect of any license or permit which may be issued to the Contractor by the Commission.

ARTICLE XXV. DEFINITIONS

1. As used in this contract:

(*a*) The term "Contracting Officer" means the person executing this contract on behalf of the Government and includes his successors or any duly authorized representative of any such person.

(*b*) The term "Commission" means the United States Atomic Energy Commission or any duly authorized representative thereof, including the Contracting Office except for the purpose of deciding an appeal under Article XVII.

In Witness Whereof the parties hereto have executed this contract as of the day and year first above written.

UNITED STATES OF AMERICA,
By J. D. ANDERSON,
Manager, Schenectady Operations Office, United States Atomic Energy Commission.

YANKEE ATOMIC ELECTRIC COMPANY,
By WILLIAM WEBSTER, *President.*

I, Donald G. Allen, certify that I am the assistant clerk of the corporation named as Contractor in the foregoing and annexed contract; that William Webster who signed this contract on behalf of the Contractor was then president of said corporation; that said contract was duly signed for and on behalf of said corporation by authority of its governing body and is within the scope of its corporate powers.

In Witness Whereof, I have hereunto affixed my hand and the seal of said corporation this 6th day of June 1956.

[CORPORATE SEAL] DONALD G. ALLEN.

APPENDIX A. RESEARCH AND DEVELOPMENT IN AEC FACILITIES

The experimental program outlined below will be carried out by the AEC in its laboratories.

1. Performance of criticality experiments on stainless steel clad UO_2 fuel elements at differing enrichment levels and including experimental determination of fast effect, resonance escape, thermal utilization, temperature coefficient and migration area in lattices at various metal to water ratios. Reactivity parameters and control rod effectiveness will be determined.

2. Performance of radiation damage experiments including fission gas release and internal pressure measurements with UO_2 stainless steel fuel elements for exposures of 10 to 30,000 MWD per ton.

3. Insertion of a UO_2 stainless steel fuel element bundle in a high temperature water cooled power reactor for burnup of 20,000 MWD per ton.

APPENDIX B. RESEARCH AND DEVELOPMENT PROGRAM IN PRIVATE FACILITIES

The research and development program outlined below will be undertaken by Yankee in private facilities.

1. *Fuel Element Development.*—The fuel element development program will be directed toward developing a satisfactory stainless steel clad UO_2 fuel element for the reactor. It is contemplated that this program will include: Study of UO_2 particle size, pelletizing, compaction, sintering, extrusion, grinding and investigation of stainless steel metallurgy, forming, welding, brazing and such other effort as may be essential to the development of the fuel element. This work will also include fabrication of some fuel elements for corrosion evaluation, thermal cycling, strength, radiation damage, X-ray and mechanical testing.

2. *Nuclear Design and Reactor Physics.*—This program will cover the principal reactor design effort including studies, experiments and calculations to develop: The basic reactor parameters, reactivity effects of temperature, burnup, fission product buildup, metal to water ratios, xenon transients; steady state and transient control requirements, radiation itensities, fuel enrichment and geometry. This phase of the work will also include planning of criticality, startup, and irradiation experiments and the analysis of resulting data and general nuclear consultation for the remainder of the project.

3. *Chemistry.*—This effort will be directed toward the evaluation of the feasibility of utilizing chemical poisoning as a means of reactor control including study of properties and chemistry of this system, radiation stability, corrosion effect and coolant cleanup problem for the chemical poisons. This will also include investigation of the crude problem, chemistry of primary loop water and chemical problems resulting from fuel element rupture.

4. *Mechnical Design.*—This project will involve the study and development of mechanical design features of the reactor including control rod drives, fuel element handling devices and core assembly with special attention to the critical factors of neutron economy and heat transfer. Also included will be study of pressure vessel closure design and other problems associated with the reactor container.

5. *Thermodynamics and Hydraulics.*—This will include investigation of the heat transfer and fluid flow characteristics of the contemplated reactor directed toward development of a design which will be satisfactory under conditions of steady state, transient and emergency operation.

6. *Control rod development.*—This program will be directed toward design and specification of reactor control rods and will include investigation of control rod materials and evaluation of most promising materials in critical facilities. This work will be coordinated with related efforts at WAPD, Argonne, and KAPL, and other Commission facilities.

7. *Instrumentation and control.*—This project will cover the investigation and development of an overall control system and instrumentation including analysis of system function and development of specifications for system components.

8. *Plant systems developments.*—This effort will involve the analysis, evaluation, and development of plant systems including primary coolant, makeup, and purification systems for the contemplated reactor. There will be maximum utilization of relevant information from the PWR project in this field.

9. *Plant safety analysis.*—This effort will involve investigation of overall plant operational safety to assure evaluation of this factor in development of final design.

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington, D. C., August 30, 1956.

The honorable the COMPTROLLER GENERAL OF THE UNITED STATES:

DEAR MR. COMPTROLLER GENERAL: A question has arisen as to the necessity for providing, in the Commission's contract with Yankee Atomic Electric Co., entered into under the Commission's power demonstration reactor program, for audit by the Comptroller General of transactions which do not involve any expenditure of Government funds.

The contract (No. AT (30-3)-222) with Yankee Atomic Electric Co. was executed June 6, 1956. A copy of the contract is attached. Its terms may be summarized as follows: Yankee will design, construct, and operate at no cost to the Commission a nuclear powerplant of specified type having an estimated net electric generating capacity of 134,000 kilowatts. Yankee will, at no cost to the Commission, keep records of technical and economic data, submit reports to the Commission as requested by it, and permit the Commission to inspect the work and activities under the contract. The Commission will perform, at no cost to Yankee, certain research and development work in its facilities at a

cost not to exceed $1 million and will pay the actual cost, not to exceed $4 million, of certain further research and development work to be performed by or for Yankee. The Commission will also waive its use charge for special nuclear material used by the contractor and will accept and reprocess or otherwise dispose of spent fuel elements in accordance with prevailing Commission policy as announced from time to time.

The project contemplated by the contract involves the construction of a large electric generating station, including a nuclear reactor, heat exchangers, turbine-generator, and primary transmission system, at an estimated capital cost of $34 million. No part of this construction cost nor of the cost of operating the plant will be borne by the Commission. Funds appropriated to the Commission will be expended under the contract only for the following:

(*a*) Research and development in the Commission's own facilities. One million dollars is obligated for this purpose under the Yankee contract but will be transferred from time to time for expenditure under the Commission's contracts with the contractors operating the Commission facilities where the work will be performed.

(*b*) Reimbursement to Yankee of the actual costs of research and development work performed by or for it. This work is identified in the contract as that which is necessary to determine the best practicable design for the powerplant; hence, it should be completed before major construction begins. Four million dollars is obligated for this purpose.

Because the company's undertaking to construct and operate the plant will be carried out with Yankee's funds and at Yankee's risk, AEC did not feel it appropriate or desirable to reserve any contractual controls over the manner of execution of that undertaking, other than the basic specification of the type and size of the plant embodied in articles I and XXII. On the other hand, in respect of the research and development work for which AEC pays the cost, it appeared appropriate to reserve the controls usual to Commission cost-type contracts. As a result, article XXIV provides that various provisions of the contract are applicable only to research and development work the cost of which will be borne by AEC. The following articles are in that category:

Article VI: Subcontracts and Purchase Orders
Article VII: Property
Article IX: State and Local Taxes
Article X: Accounts, Records, and Inspection
Article XI: Drawings, Designs, Specifications
Article XII: Labor
Article XIII: Domestic Preference
Article XIV: Security
Article XV: Safety, Health, and Fire Protection
Article XVII: Disputes
Article XXI: Renegotiation

Article XVI of the contract is the usual examination of records provision, specified by section 166 of the Atomic Energy Act of 1954. During the course of negotiations the contractor strongly requested that the application of article XVI be similarly limited to that portion of the work for which the Commission would be making payments. After informal discussion with representatives of your office, it was concluded that that request presented a matter on which your advice should be obtained. Because the parties were extremely anxious to execute a contract as promptly as possible, the contract was executed without any limitation on the applicability of article XVI. However, simultaneously with its execution, the manager of our Schenectady operations office, who executed the contract on behalf of the Commission, sent Yankee a letter, a copy of which is attached, which contains an undertaking that in the event it is determined by the Comptroller General that the Commission is not legally required to make article XVI applicable to all work and activities under the contract, the Commission will be willing to agree to an amendment to the contract which will limit the applicability of article XVI appropriately.

In requesting that the application of articles XVI be limited to that work the cost of which will be reimbursed by the Commission, Yankee has stated that while it is, of course, subject to regulation by appropriate State authorities, it does not perceive the appropriateness of audit by the Comptroller General of its transactions involved in the construction and operation of the nuclear powerplant where those transactions do not involve any expenditure of Government funds. In addition, it points out that it plans to subcontract substantially all

of the design and construction of both the nuclear and conventional portions of the plant and that it anticipates objection on the part of its subcontractors to the inclusion of a provision for audit by the Comptroller General of subcontracts not involving the expenditure of Government funds.

Section 166 of the Atomic Energy Act provides as follows:

"No moneys appropriated for the purposes of this Act shall be available for payments under any contract with the Commission, negotiated without advertising, except contracts with any foreign government or any agency thereof and contracts with foreign producers, unless such contract includes a clause to the effect that the Comptroller General of the United States or any of his duly authorized representatives shall, until the expiration of three years after final payment, have access to and the right to examine any directly pertinent books, documents, papers and records of the contractor or any of his subcontractors engaged in the performance of, and involving transactions related to such contracts or subcontracts: *Provided, however,* That no moneys so appropriated shall be available for payment under such contract which includes any provision precluding an audit by the General Accounting Office of any transaction under such contract."

Section 166 derives from a rider to the Independent Offices Appropriation Act, 1953 (66 Stat. 396), which appears to have been adopted primarily out of concern to insure the right of the Comptroller General to audit cost-type contracts of the Commission in order to ascertain whether Government funds were being properly expended. (See 98 Congressional Record 2525–2527, 2614.)

In the Commission's view that section is clearly applicable to the contract because the contract will involve payments to Yankee in respect of the research and development work to be performed by or for Yankee. It is also our view, however, that in the present context the "directly pertinent" books, documents, papers and records of the contractor and his subcontractors are those which are directly pertinent to that aspect of the contract in respect of which payments of Government funds will be made to Yankee. Accordingly, we believe the terms and intent of the audit rider would be satisfied if the application of article XVI of the contract were limited to the research and development work to be performed by or for Yankee, the costs of which will be paid for by the Commission—i. e., the work for which the Commission has obligated $4 million. Of course, the work to be done in Commission facilities, for which the Commission has obligated $1 million, will be performed subject to the Commission's operating contracts with contractors operating those facilities, and will, by the terms of those contracts, be subject to audit by the Comptroller General.

This conclusion is reinforced by consideration of the Commission's purpose in entering into the contract with Yankee Atomic Electric Co. That contract is the first executed by the Commission under its power demonstration reactor program. Accordingly, a brief description of that program appears appropriate.

The Commission is authorized and directed by section 31a of the Atomic Energy Act of 1954 to make arrangements (including contracts, agreements, and loans) for the conduct of research and development activities relating among other things, to the demonstration of the practical value of utilization or production facilities for industrial or commercial purposes. One of the most important areas in which such facilities may have practical value is the use of nuclear reactors to produce electric energy. The Commission has for many years been performing experimental and developmental work in the field of atomic power. In 1953 it contracted for the construction with Government funds of a 60,000-kilowatt nuclear powerplant at Shippingport, Pa.

In reporting out the legislation which became the Atomic Energy Act of 1954, the Joint Committee on Atomic Energy stated:

"Many technological problems remain to be solved before widespread atomic power, at competitive prices, is a reality. It is clear to us that continued Government research and development, using Government funds, will be indispensable to a speedy and resolute attack on these problems. It is equally clear to us, however, that the goal of atomic power at competitive prices will be reached more quickly if private enterprise, using private funds, is now encouraged to play a far larger role in the development of atomic power than is permitted under existing legislation. In particular, we do not believe that any developmental program carried out solely under governmental auspices, no matter how efficient it may be, can substitute for the cost-cutting and other incentives of free and competitive enterprise" (S. Rept. No. 1699, H. R. Rept. No. 2181, 83d Cong., 2d sess., p. 3).

One of the principal means adopted by the Commission to encourage private enterprise, using private funds, to play a larger role in the development of atomic power is its power demonstration reactor program, which was first announced January 1, 1955. Under that program the Commission offered to contract with publicly, cooperatively, and privately owned utility organizations and with equipment manufacturers, for the extension of limited Commission assistance to projects proposed by the contractors for the construction and operation of nuclear powerplants. In return for such assistance the Commission would receive full technical and economic information relating to the project. In order to preserve the cost-cutting and other incentives to which the Joint Committee's report referred, the program contemplates that the Commission's assistance will be subject to fixed limits, and that the project, except for such assistance, will be financed by and at the risk of the proposing organizations. Funds for such assistance have been included in fiscal years 1956 and 1957 appropriations.

The power demonstration reactor program rested on the fact that production of electric energy nuclear means has not yet been shown to be competitive with conventional generation, and that the economics of nuclear production of energy are not fully known. Further, it was apparent that construction of full-scale plants was, at the appropriate stage in technological development, the best means of obtaining technical and economic information needed to determine the economic potentialities of different reactor types. The power demonstration reactor program was designed to encourage industry to construct such reactors with limited Government assistance, as an alternative to direct Government construction. Since the Commission had a current need for the technical and economic information to be obtained from the construction and operation of the reactor, and since that need could be satisfied at less expense to the Government by offering assistance to privately financed projects than by construction of Government plants, the Commission felt warranted in offering to obligate itself to furnish such assistance in consideration for the proposer's undertaking to construct and operate the reactor and furnish the information from it.

There are attached hereto press releases dated January 10, 1955, April 7, 1955, and September 21, 1955, announcing and describing the power demonstration reactor program. General description and discussion of it is also contained in the Commission's testimony before the Joint Committee on Atomic Energy in hearings on the Development, Growth, and State of the Atomic Energy Industry, February 1956, pages 78–80; see also hearing before the Joint Committee on Atomic Energy on Proposed Legislation for Accelerating Civilian Reactor Program, S. 2725 and H. R. 10805, May 1956, pages 23–71.

As we have pointed out, one of the purposes of the power demonstration reactor program is to encourage the construction of power reactors by the normal methods and under the normal incentives of private business. Consistently with that purpose, the Yankee contract contemplates that the design, construction, and operation of the nuclear powerplant will be at the responsibility and financial risk of Yankee. In our view this responsibility should not be diluted by the retention of Government controls over the design, construction, and operation of the plant unless such controls are clearly necessary to protect the interest of the United States.

For the foregoing reasons we believe it would be permissible to amend the Yankee contract so as to include article XVI, "Examination of records," among the articles whose application is limited by article XXIV. However, because of doubts created by certain expressions in volume 32, Comptroller General, page 278, at 280, we have felt that we should submit the matter for your advice.

Sincerely yours,

K. E. FIELDS, *General Manager.*

COMPTROLLER GENERAL OF THE UNITED STATES.
Washington, October 10, 1956.

Hon. LEWIS L. STRAUSS,
Chairman, Atomic Energy Commission.

DEAR MR. STRAUSS: Reference is made to the General Manager's letter of August 30, 1956, requesting our views as to the necessity for providing for audit by the Comptroller General of transactions under contract No. AT(30–3)–222 with Yankee Atomic Electric Co. which do not involve any expenditure of Government funds.

The contract with Yankee was executed June 6, 1956, in furtherance of the Commission's power demonstration reactor program. The aim of that program, as stated in the Commission's release of January 10, 1955, is to bring private resources into the development of engineering information on the performance of nuclear power reactors and to advance the time when nuclear power will become economically competitive. The contract provides that Yankee will design, construct, and operate a nuclear powerplant having an estimated 134,000-kilowatt generating capacity. Yankee is to furnish the Commission information on technical, economic, and operating aspects of the project during the development, design, construction, and operating phases. The Commission is to perform certain research and development work to cost no more than $1 million, and has agreed to pay the actual cost, not to exceed $4 million, of certain further research and development work to be performed by or for Yankee. The Commission has also agreed to waive its use charge for special nuclear material used by the contractor during development of the plant and for the first 5 years of operation. All other costs of design, construction, and operation of the project are to be borne by Yankee.

As executed, the contract contains the usual examination of records provision which gives the Comptroller General the right to examine any directly pertinent books, documents, papers, and records of the contractor or any of his subcontractors involving transactions related to the contract until 3 years after final payment thereunder. During the contract negotiations the contractor requested that the foregoing provision be limited in its application to that portion of the work for which payment would be made by the Commission, and the Commission indicated its willingness to agree to a contract amendment so providing if the Comptroller General should determine this to be legally permissible.

The law applicable is section 166 of the Atomic Energy Act of 1954, 68th United States Statutes at Large, pages 951–952, which provides, in pertinent part, as follows:

"No moneys appropriated for the purposes of this Act shall be available for payments under any contract with the Commission, negotiated without advertising * * * unless such contract includes a clause to the effect that the Comptroller General of the United States or any of his duly authorized representatives shall, until the expiration of three years after final payment, have access to and the right to examine any directly pertinent books, documents, papers and records of the contractor or any of his subcontractors engaged in the performance of, and involving transactions related to such contracts or subcontracts: * * *"

As stated in the general manager's letter, there is no doubt as to the general applicability of the law to the contract in view of the payment of $4 million (or less) to be made to Yankee as reimbursement for the cost of the research work which it will perform. Consequently, the inclusion of the examination of records clause in the contract was not only proper but was legally required to validate such payment. It seems to us that the real question presented by the contractor's request for a limited application of the clause involves the meaning of the clause rather than its applicability.

The right of examination given is confined to "any directly pertinent" records "involving transactions related to" the contract or subcontracts. The effect of the suggested modification to the contract would be tantamount to that of a contractual agreement between Yankee and the Commission that the only records which would be considered "directly pertinent" under the clause would be those pertaining to the reimbursable work. In our opinion such an interpretation of the clause, and of the law, would not be justified in the case of the contract under consideration. The basic reason for the Government's participation in the project was to secure information concerning the cost of nuclear production of energy. While it is true that the Government will not bear any of the construction or operating costs, such costs are an essential element of the overall knowledge which is the main consideration moving to the Government under the contract. For this reason we believe that construction and operating cost data are "directly pertinent" to the contract within the meaning of section 166 of the Atomic Energy Act of 1954, especially in view of the contractor's specific obligations under article I–1.e. It is accordingly our view that the contract would be subject to question if such an audit were precluded.

Sincerely yours,

JOSEPH CAMPBELL,
Comptroller General of the United States.

REPORT ON REVIEW OF ATOMIC ENERGY COMMISSION CONTRACT NO. AT(30-3)-222 WITH YANKEE ATOMIC ELECTRIC CO., NOVEMBER 1956, BY THE COMPTROLLER GENERAL OF THE UNITED STATES

INTRODUCTION

On June 4, 1956, the Atomic Energy Commission (AEC) entered into the first contract under its power demonstration reactor program. The purpose of this program, initially announced on January 10, 1955, is to facilitate bringing private resources into the development of technical and economic data on the performance of nuclear power reactors and to advance the time when nuclear power will become economically feasible.

Because this is the first contract under a program that has worldwide significance, we believe that it is important to make a timely report on the negotiation and terms of the contract. Our recommendations for the Commission's consideration in the negotiation of future contracts under this program are on page 8.

AEC's first contract is with the Yankee Atomic Electric Co. (Yankee), a newly formed company which is wholly owned by 12 New England public utility companies.

Briefly, the Yankee contract provides that:

1. Design, research, and development work on a pressurized water type of reactor and related fuel elements will be performed by AEC and Yankee. AEC will bear the actual cost of this work up to $5 million. Costs in excess of this amount, if any, will be borne by Yankee.

2. Yankee will construct and operate a nuclear powerplant, which will be powered by heat produced from a pressurized water type of reactor and will have an estimated net electrical generating capacity of 134,000 kilowatts.

3. Yankee will bear all capital costs, estimated to be $33,400,000, and will bear all operating costs except the established AEC special nuclear material use charge (hereinafter termed "material use charge") which is waived by AEC for the contract period. AEC estimates that its loss of revenue because of this waiver will be $3,300,000.

4. The contract will terminate 5 years after issuance of a license to operate the facility.

Research and development work started in June 1956 and is scheduled to continue through 1960. Yankee applied for a construction permit and other required preoperation licenses on June 29, 1956. At October 15, 1956, Yankee had not submitted all the information needed by AEC for its review of Yankee's application for such preoperation licenses.[1] Yankee estimates that it will start construction about June 1957 and will complete the plant between December 1959 and June 1961. Before the plant may be operated, Yankee must apply for and obtain an operating license from AEC.

Our comments are based on a study of the contract between AEC and Yankee; on a study of Yankee's proposals, AEC's negotiation records, and other related data; and on discussions with AEC officials. The summary section of this report includes our comments and opinions on significant matters relating to the contract, including compliance with AEC stated policies. We express no opinion on AEC policy decisions, such as the type of reactor approved for support by AEC and the level of assistance provided by AEC.

SUMMARY

Our major comments are summarized below. Where appropriate, a page reference is given for a more complete discussion of the subject.

PURPOSE OF THE CONTRACT

The purpose of the Yankee contract is to facilitate a cooperative effort on the part of AEC and Yankee to obtain technical and cost data on a nuclear power reactor. This information, which is expected to lead to further technical advances in subsequent power reactors, will be made available to the public. (See pp. 10 through 13.)

[1] We have been informed that the preoperation licenses have not been issued as of January 17, 1957.

FINANCIAL COMPETENCY OF THE CONTRACTOR

Yankee is a newly formed company which is wholly owned by 12 New England public utility companies; however, these companies have not yet executed binding agreements with Yankee covering their proposed capital contributions to Yankee and the purchase of power produced by Yankee. We believe that, because of this lack of firm agreements between Yankee and its sponsors, Yankee has not demonstrated its financial competency and that AEC executed the contract without adequate assurances that the Government will receive benefits commensurate with its investment. (See pp. 14 through 16.)

TECHNICAL CONTRIBUTION OF THE YANKEE REACTOR

The pressurized water type of reactor that Yankee intends to build is considered by AEC to be essentially the same as both the AEC-owned reactor which is currently being constructed at Shippingport, Pa., and the reactor that Consolidated Edison Co., of New York, proposes to build without AEC financial assistance. We understand that the principal differences between these three reactors are in the design and composition of the cores. After weighing the advantages and disadvantages of this situation, AEC concluded that the Yankee reactor would make a contribution toward the advancement of reactor technology, particularly during the period of actual operations. (See p. 19.)

CHANGE IN AEC ASSISTANCE POLICY

After Yankee's second proposal had been accepted on February 8, 1956, as a satisfactory basis for negotiation of a contract, Yankee requested AEC to grant it a substantially longer period for AEC's waiver of the material use charge. The period requested, which AEC granted, was the waiver period AEC had previously announced on September 21, 1955, that it would consider for assisting organizations interested in building small-scale nuclear powerplants. AEC estimates that this change in policy will cost an additional $1,600,000 through loss of revenue under the Yankee contract. Also, AEC applied this change in policy to two other draft contracts for large nuclear powerplants. We have been informed that the additional loss of revenue under these draft contracts cannot be determined, at this time, because the project plans have not been finalized. (See pp. 20 through 22.)

CONTRACT PROVISIONS

The contract provides that Yankee will design, construct, and operate a nuclear powerplant powered by a pressurized water type of reactor capable of producing 134,000 kilowatts of electricity and that Yankee will bear all the costs thereof except costs which AEC agrees to bear. AEC agrees to bear costs estimated at $8,300,000—consisting of a maximum of $1 million for research and development work performed by AEC in its own facilities, a maximum of $4 million for research and development work performed by Yankee and its subcontractors, and an estimated $3,300,000 in loss of revenue through waiver of established AEC material use charges. AEC will receive all technical and cost data that it requests, and such data will be disseminated as AEC determines appropriate. (See pp. 23 through 27.)

WAIVER OF SPECIAL NUCLEAR MATERIAL USE CHARGE

AEC announcements for the power demonstration reactor program state that the Commission will consider providing assistance to applicants by waiving its established charges for use of special nuclear materials up to an agreed-upon amount of money. The Yankee contract does not fully comply with this policy since it provides that AEC will waive its use charge, without limitation, for all special nuclear material used during the contract period. (See p. 28.)

RISK ASSUMED BY YANKEE

AEC believes that the best measure of total risk in this completely new industry is obtained by considering the dollar investment of the contractor. Yankee estimates that its permanent financing program will be about $33 million; however, formal arrangements have not been made to obtain such an amount.

According to Yankee's schedule of estimated cash expenditures, its major expenditures of funds will be made in 1959 and 1960. (See pp. 28 and 29.)

ASSURANCES AGAINST ABANDONMENT OF THE PROJECT

Neither Yankee nor its 12 sponsoring companies have given contractual assurances that Yankee will perform the work called for under the contract. AEC's position on this point is that Yankee expressed its intention to see the project through to completion, and that Yankee's sponsoring companies will have substantial amounts of money invested in the project and will have considerable prestige at stake. For these reasons, AEC believes that a decision to abandon the project will not be taken lightly by Yankee. (See pp. 29 and 30.)

AEC CONTROLS

In our opinion, the contract provides a basis for adequate control over the technical aspects of all work performed by Yankee. It also provides a basis for adequate control over the cost of work by Yankee which will be reimbursed by AEC. However, we note that the contract does not specifically provide that AEC has the right to audit costs which AEC does not bear. We believe that AEC should have the right to audit all transactions related to the contract so that it can assure itself as to the accuracy of the cost information prepared by Yankee. The contract contains the usual examination of records provision, specified by section 166 of the Atomic Energy Act of 1954, which gives the Comptroller General of the United States the right to audit all transactions related to the contract. In response to AEC's inquiry, on October 10, 1956, the Comptroller General informed the Commission that an amendment to the contract precluding such an audit would subject the contract to question. (See pp. 30 through 32.)

RECOMMENDATIONS

The following recommendations are based on findings contained in this report and summarized in the previous section.

We recommend that the Commission make an intensive effort to persuade Yankee to immediately enter into formal and binding agreements with its sponsoring companies providing for the purchase of its capital stock.

Since the Yankee contract is the first contract executed under AEC's power demonstration reactor program and may be used as a guide in the negotiation of future contracts under this program, we believe that the Commission should consider adopting the following recommendations for use in such future negotiations.

1. When the party making the proposal is sponsored by other parties, we recommend that the Commission require the applicant to obtain binding agreements from its sponsors covering the sponsors' capital contributions to the applicant. Such agreements should be obtained prior to the execution of a contract between the Commission and the applicant. This recommendation is directed to strengthening the Commission's assurances of the applicant's financial competence.

2. When the party making the proposal is sponsored by other parties, we recommend that the Commission obtain from the sponsors a guaranty that the applicant will perform the work contemplated in the proposal. This recommendation is directed to strengthening the Commission's assurances against the applicant's abandonment of the project.

3. Although AEC's power demonstration reactor program contemplates the applicant's using its own funds with only limited Government financial assistance, we recommend that AEC obtain the right to audit all transactions related to the contract. We believe that it would be fair for AEC to insist on such a right since technical and financial knowledge gained by the contractor and supplied to the Commission is the main consideration moving to the Government under the contract. This recommendation is directed to giving to the Commission the opportunity to assure itself as to the accuracy of cost and other financial data prepared by the contractor.

By letter dated February 13, 1957, the General Manager of the Atomic Energy Commission stated that the Commission intends to adopt our recommendations in pending and future contract negotiations. His letter, in pertinent part, is quoted.

"As stated to your representatives, it is the AEC's intention to make every effort to secure binding financing agreements and performance guaranties in those cases where the proposer is sponsored by other companies and to have its files pertaining to pending and future contract negotiations fully reflect these efforts. Similarly, we propose to contractually obtain the right to examine such

financial data pertaining to the costs incurred under the contracts, as is pertinent and necessary to the accomplishment of our programmatic purposes, irrespective of whether such costs are borne by AEC."

Power Demonstration Reactor Program

AEC is authorized and directed by section 31a of the Atomic Energy Act of 1954 (42 U. S. C. 2051) to make arrangements (including contracts, agreements, and loans) for the conduct of research and development activities relating to the demonstration of the practical value of nuclear material utilization or production facilities for industrial or commercial purposes.

AEC believes that one of the most important areas in which such facilities may have practical value is the use of nuclear reactors to produce electric energy. AEC adopted a power demonstration reactor program as one of its principal means to encourage private industry, using private funds with limited Government financial assistance, to take a larger role in the development of nuclear power.

In announcing this program on January 10, 1955 ("first round"), AEC provided that proposals for AEC cooperation could be submitted up to April 1, 1955, by applicants who were willing to assume the risk of construction, ownership, and operation of reactors designed to demonstrate the practical value of such facilities for industrial or commercial purposes. AEC stated that it would consider providing the following types of cooperation and assistance:

"(*a*) Waiving the established Commission charges for loan of source and special nuclear materials up to an agreed upon amount for a period of up to 7 years from July 1, 1955. However, the licensees will be required to pay for materials consumed in the demonstration project and for services performed for them by the AEC, such as recovery of materials from spent fuel elements;

"(*b*) Performing in AEC laboratories without charge to the licensees certain mutually agreed upon research and development work;

"(*c*) Entering into research and development contracts under section 31a, for the technical and economic information resulting from development, construction, and operation of power demonstration reactors by contractors. The amounts to be paid by AEC under the contracts will be fixed in advance and may be used for development, fabrication, and experimental operation. Information derived from operations under the contracts will be made available by AEC to the maximum extent practicable to the entire technical public working on reactor development, with resultant benefit to the progress of the entire nuclear power program."

AEC stated also that it would employ the following criteria in evaluating proposals:

"(*a*) Probable contribution of the proposed project toward achieving economically competitive power;

"(*b*) Cost to AEC in funds and materials;

"(*c*) Risk to be assumed by the maker of the proposal;

"(*d*) Competence and responsibility of the maker of the proposal;

"(*e*) Assurances given by the maker of the proposal against abandonment of the project."

On September 21, 1955, AEC announced the "second round" of their power demonstration reactor program. This announcement provided that proposals for small-scale nuclear powerplants capable of producing 5,000 to 40,000 kilowatts of electricity could be submitted up to February 1, 1956. AEC stated that it would consider the following types of assistance:

"(*a*) Waiver of the established Commission charges for use of source and special nuclear materials, up to an agreed upon amount of money, for a period not greater than 5 years from the issuance of the license to operate the facility. Otherwise full charges will be made, for services and for materials used or sold in accordance with existing Commission policy and practices.

"(*b*) Performing in AEC laboratories without charge, or at less than full cost, up to a fixed dollar amount, mutually agreed upon research and development using specialized facilities, personnel, or equipment.

"(*c*) Entering into fixed amount research and development contracts with the proposer under section 31a of the Atomic Energy Act of 1954 for the technical and economic information resulting from development, design,

construction, and operation of the nuclear powerplant. Payments under these contracts may be used to defray part of the costs of development, design, and engineering of the reactor portion of the plant, and a part of the experimental operation of the plant for a period not to exceed 5 years after issuance of the license to operate the facility. No part of the payments made under these contracts may be used to defray any part of the capital costs of the reactor proposed. Information obtained by the AEC through contracts of this type and for this purpose will be made available to the maximum extent practicable to the entire technical public.

"(*d*) Financing and retaining title to all or part of the reactor system. The nature and extent of this type of assistance will determine whether the energy generated in the reactor will be subject to disposition in accordance with section 44 of the Atomic Energy Act of 1954 and its provisions regarding disposal of energy from utilization facilities of the Commission."

AEC stated also that it would employ the following criteria in evaluating proposals:

"(*a*) Cost to the AEC in funds, materials, and services.

"(*b*) Probable contribution of the proposed project toward achieving economically competitive power in a plant of the size proposed. The Commission will take into consideration the technological advancement represented by the proposed design.

"(*c*) Technical and financial competence of the party making the proposal, either by himself or in combination with others from whom he has received at least binding letters of intent, to meet the responsibilities entailed in the proposal, including but not limited to development, design, engineering, construction, ownership, and subsequent operation of the nuclear powerplant proposed.

"(*d*) Degree of enrichment of the fuel in the isotope U–235. Under this criterion proposals calling for 10 percent or less enrichment will be given more favorable consideration than those calling for more than 10 percent."

Further information relating to this program is contained in a letter to the Comptroller of the United States, from the General Manager of the Atomic Energy Commission, dated August 30, 1956, which is quoted, in pertinent part, below:

"The power demonstration reactor program rested on the fact that production of electric energy by nuclear means has not yet been shown to be competitive with conventional generation, and that the economics of nuclear production of energy are not fully known. Further, it was apparent that construction of full-scale plants was, at the appropriate stage in technological development, the best means of obtaining technical and economic information needed to determine the economic potentialities of different reactor types. The power demonstration reactor program was designed to encourage industry to construct such reactors with limited Government assistance, as an alternative to direct Government construction. Since the Commission had a current need for the technical and economic information to be obtained from the construction and operation of the reactor, and since that need could be satisfied at less expense to the Government by offering assistance to privately financed projects than by construction of Government plants, the Commission felt warranted in offering to obligate itself to furnish such assistance in consideration for the proposer's undertaking to construct and operate the reactor and furnish the information from it."

In summary, the power demonstration reactor program provides for a cooperative effort on the part of AEC and private industry; AEC will bear part of the costs associated with the nuclear power reactors and in return will receive technical and economic data for dissemination to the public.

Description of the Yankee Atomic Electric Co.

SPONSORING COMPANIES

The Yankee Atomic Electric Co. (Yankee) was incorporated as a Massachusetts electric utility company on September 17, 1954. It was organized to provide a vehicle for a cooperative effort by certain of the major New England utilities

in constructing and operating a nuclear powerplant of commercial size. Yankee's sponsors and their proposed percentage of stockownership are shown below:

	Percent
New England Power Co	30.0
Connecticut Light & Power Co	15.0
Boston Edison Co	9.5
Central Maine Power Co	9.5
Hartford Electric Light Co	9.0
Western Massachusetts Electric Co	7.0
Public Service Company of New Hampshire	7.0
Montaup Electric Co	4.5
Central Vermont Public Service Corp	3.5
New Bedford Gas & Edison Light Co	2.5
Cambridge Electric Light Co	2.0
Connecticut Power Co	.5
Total	100.0

FINANCIAL ARRANGEMENTS

At the time Yankee submitted its original proposal to AEC (March 30, 1955) and its second proposal (August 22, 1955) which replaced the original one, Yankee had no securities outstanding, funds, or other assets. At hearings before the Securities and Exchange Commission (SEC), concluded in November 1955, Yankee indicated that its permanent financing program had not been definitely determined but that it would probably be as follows:

Common stock investment of sponsors	$14,000,000
Funded debt	19,000,000
Total	33,000,000

At these hearings, Yankee stated that it did not have formal agreements with the sponsoring companies covering the purchase of capital stock or the purchase of power generated, but that there was an informal understanding on these matters. Yankee informed AEC, almost a year later on October 24, 1956, that formal agreements on these matters still had not yet been entered into.

Subsequent to the SEC hearings, Yankee informed AEC that it did not foresee any regulatory difficulties in raising as much as $40 million, if needed. Also, Yankee has informed AEC that in December 1955 it received $1 million by sale of $500,000 each of capital stock and short-term notes to the sponsoring companies. Further, Yankee informed AEC that it had received permission from the Securities and Exchange Commission on May 25, 1956, to consult with financial groups as to Yankee's financial structure and requirements.

In determining whether Yankee met the "competence and responsibility of the maker" criteria for evaluating the "first round" original proposals, the AEC Selection Board reported that:

"The contributing members of this company all appear to be sound organizations. Their responsibility is, of course, legally limited since the work is to be performed by a corporation, Yankee, formed last year to carry on studies of the reactor program. Based upon the amounts proposed to be contributed and the proposed capital structure, this organization appears financially and managerially competent to carry out the project. * * *"

We understand that this evaluation also applies to Yankee's second proposal.

We believe that, because of the lack of firm agreements between Yankee and its sponsors, Yankee has not demonstrated its financial competency and that AEC executed the contract without adequate assurance that the Government will receive benefits commensurate with its investment.

YANKEE PROPOSAL

YANKEE'S ORIGINAL PROPOSAL

The original proposal by Yankee, dated March 30, 1955, provided for the construction and operation of a nuclear powerplant capable of producing about

100,000 kilowatts of electricity from heat produced by a pressurized water type of reactor. Assistance requested by Yankee from AEC is summarized below:

1. Research and development, prior to startup	$2,300,000
2. Research and development, after startup	2,500,000
3. Waiver of material use charge to July 1, 1962	5,720,000
4. Waiver of material use charge after July 1, 1962	11,440,000
5. Reprocessing and shipping of spent fuel	13,050,000
6. Capital costs	1,700,000
Total assistance requested	36,710,000

On August 8, 1955, AEC notified Yankee that assistance requested in items 4, 5, and 6 ($26,190,000) did not conform with the intent of AEC's announcement on the power demonstration reactor program, and meetings were arranged to discuss the possibility of changing the proposal to conform with the announcement.

YANKEE'S SECOND PROPOSAL

While its original proposal was being considered by AEC, Yankee made additional technical studies on reactors and came to the conclusion that, because of technical problems, its original concept of a pressurized water reactor was not the most practical one available. Because of these technical difficulties, Yankee withdrew its original proposal on August 22, 1955, and submitted, in its place, a proposal for a 134,000-kilowatt nuclear powerplant powered by heat produced from a pressurized water type of reactor of a different technical concept. Assistance requested from AEC in the second proposal is summarized below:

Research and development, prior to startup	$5,000,000
Waiver of material use charge to July 1, 1962	1,700,000
Research and development, after startup	2,500,000
Total assistance requested	9,200,000

Capital and operating costs

Yankee estimated that its capital costs would amount to $33,400,000—$16 million for construction of the nuclear portion of the plant and $17,400,000 for construction of the conventional facilities and for other costs.

Further, Yankee estimated that, for the first 5 years of its operations, revenues would amount to $41,430,000 and costs would amount to $42,950,000. The sources of estimated revenues were $32,950,000 from the sale of power to the sponsoring companies and $8,480,000 from the sale of byproduct nuclear material to AEC. Power revenues were based on an annual demand charge of $30 per kilowatt and an energy charge of 3.5 mills per kilowatt-hour. The estimated operating costs were exclusive of any material use charge to July 1, 1962. They included $3 million for contingencies. Depreciation on the reactor portion of the plant was calculated to provide a 50 percent writeoff as of the end of the first 5 years of operations; however, straight-line depreciation over a 30-year life was used for the conventional portion of the plant. Based on these figures,[2] accumulated losses for the 5-year period would be $1,520,000.

Type of reactor

The reactor contemplated in Yankee's second proposal, a pressurized water type of reactor, is considered by AEC to be essentially the same as the AEC-owned reactor which is currently being constructed at Shippingsport, Pa., except for certain design features of the core not included in the original Shippingsport reactor. In connection with this point, we were informed by AEC that the reactor planned to be built by Consolidated Edison Company of New York, without AEC financial support, is essentially identical with the Shippingsport reactor and the Yankee reactor, the principal differences being in the design and composition of the cores.

After considering the favorable and unfavorable aspects of supporting two essentially identical plants, AEC concluded that the Yankee plant would make contributions to civilian power reactor technology, particularly during actual plant operations. Because of the similarity between the proposed Yankee reactor and the other reactors noted above, the contract specifies that Yankee and

[2] These figures do not reflect the additional assistance granted to Yankee by AEC's extending its waiver period for material use charge beyond July 1, 1962. (See p. 21.)

AEC will cooperate to assure that unnecessary duplication of research and development work is not performed at Government expense.

Need for Government assistance

After Yankee had submitted its second proposal in August 1955, Yankee indicated at the SEC hearings concluded in November 1955 that it would build a nuclear powerplant even if AEC refused financial assistance. When AEC became aware of this statement it took the position that Yankee should apply for a license without any AEC financial participation in the project. During December 1955 and January 1956, Yankee undertook to reconcile its proposal to AEC with its testimony before the SEC. Yankee's principal argument for requesting AEC assistance was that without such assistance the reactor that it would build would be smaller and would be built at a later date than the one proposed to AEC. On January 27, 1956, Yankee revised its second proposal (see p. 18) by withdrawing its request for $2,500,000 for research and development after startup. On February 8, 1956, AEC approved the second proposal, as revised January 27, 1956, as an acceptable basis for negotiation of a contract.

AEC waiver of special nuclear material use charge

During contract negotiations, which took place from February 1956 through May 1956, Yankee requested AEC to extend the period for waiver of the material use charge beyond that stated in Yankee's second proposal. Yankee wanted a waiver for the maximum period that AEC announced, on September 21, 1955, it would consider when reviewing proposals for small-scale nuclear powerplants ("second round"). The "second round" announcement limited proposals to nuclear powerplants capable of producing 5,000 to 40,000 kilowatts of electricity. Since electricity produced by plants of this size is expected to cost more than electricity produced by larger plants, the assistance to be considered by AEC under the "second round" is substantially broader than that announced under the "first round." The significant differences are:

1. AEC may finance and retain title to the reactor portion of the plant under the "second round," whereas, under the "first round," the entire plant cost is to be borne by the proposers.

2. The actual material use charge waiver period under the "second round" may be substantially longer than that announced under the "first round."

The effect of Yankee's request was that, instead of a material use charge waiver for about 2½ years of operations, at a cost to AEC of about $1,700,000, as allowable under the "first round" announcement, it wanted a material use charge waiver for 5 years of operations, at a cost to AEC of about $3,300,000, as allowable under the "second round" announcement. AEC justified its agreement to Yankee's request for the material use charge waiver for the 5-year period on the following basis:

1. The change in policy on material use charge waivers from that stated in the "first round" announcement allows uniformity of treatment to all demonstration proposers. Draft contracts with two other "first round" proposers, Consumers Public Power District of Nebraska and Power Reactor Development Co., were also revised to the "second round" waiver basis.

2. A waiver of charges during the first 5 years of operations is a fair reflection of the probability that a demonstration nuclear powerplant project will require approximately this long a period for the development of improved fuel elements permitting more nearly economic plant operations.

The AEC contract with Yankee was executed on June 4, 1956.

In connection with the change in AEC policy regarding the material use charge waiver for "first round" proposers, we believe that the following points should be noted.

1. As a result of this change in policy, AEC estimates that, under the Yankee contract, it will bear additional costs of $1,600,000 through loss of revenue from the material use charge. In addition, the application of this change in policy to the draft contracts with the Consumers Public Power District of Nebraska and the Power Reactor Development Co. will result in higher waiver costs to AEC than would have been allowed under the "first round" announcement. AEC has informed us that it is unable to make meaningful estimates of the additional cost through loss of revenue under these two draft contracts because the project plans have not been finalized.

2. Prior to the policy change, Yankee and the two other "first round" proposers had accepted the "first round" basis for the material use charge waiver and contracts were being negotiated on that basis.

3. The announcement for both "rounds" indicate that proposals are to be considered on a "competitive basis" and that cost to AEC is an important factor in deciding if a proposal is acceptable to AEC.

Summary of Significant Contract Provisions

Provisions applicable to all work performed under the contract

Undertakings by Yankee

1. Yankee shall perform and have performed such design, research, and development work as may be necessary to determine the best practical design for the nuclear powerplant and shall construct and operate such plant and bear all costs in connection therewith except costs which AEC agrees to bear. (AEC's contribution is estimated to be $8,300,000.)

2. Yankee shall obtain all necessary licenses from regulatory authorities as are required for construction and operation of the plant and sale or use of energy produced therein. AEC does not represent that licenses or approvals will be granted.

3. Yankee shall keep records of technical, economic, and operating data developed by it and its subcontractors and shall, during the contract period, submit reports and information thereon as requested by AEC. AEC has the right to inspect the work at any time and to use and distribute, to others, data pertaining to the work under the contract.

4. Yankee shall exert its best efforts to avoid duplication of research and development work performed or being performed in the development of pressurized water type of reactors. AEC will make such information available to Yankee.

Undertakings by AEC

1. AEC shall perform or have performed certain research and development work in its own facilities and shall bear the cost thereof up to $1 million. Any excess cost shall be paid by Yankees if a Yankee approves the additional work in advance of performance.

2. AEC shall bear the actual cost of certain research and development work performed by Yankee and its subcontractors up to a maximum of $4 million.

3. AEC shall waive its material use charge for the term of the contract. (AEC estimates that this waiver will cost $3,300,000 through loss of revenue.)

4. If requested, AEC shall reprocess or dispose of spent fuel elements in accordance with prevailing AEC policy as announced from time to time.

Inventions

With respect to work reimbursed by AEC, any invention or discovery is to be brought to AEC's attention, and AEC has the sole right to determine if a patent application should be filed. In addition, AEC has the right to dispose of the title to and the rights under any application or patent which may result. Yankee, however, shall retain at least a nonexclusive, irrevocable, royalty-free license under such application or patent.

With respect to work not reimbursed by AEC, any invention or discovery is to be brought to AEC's attention and Yankee shall state whether it desires to file a patent application. Yankee agrees to grant the Government a nonexclusive, irrevocable, royalty-free license for governmental purposes under such application or patent. If Yankee doesn't want to file a patent application, then AEC has the same rights as it has with respect to work reimbursed by AEC.

Option to purchase

If, at any time after construction of the reactor portion of the powerplant starts, Yankee fails to continue construction or operation of the plant, AEC has the right to purchase the reactor plant and related facilities, excluding the power-generating plant and equipment. The purchase price is to be mutually agreed upon but will not be in excess of cost (excluding research and development) less applicable depreciation.

Examination of records

The General Accounting Office has the right to examine any directly pertinent books, documents, papers, and records of Yankee and of its subcontractors involving transactions related to the contract, until 3 years after final payment thereunder.

Termination

The contract may be terminated at any time, without penalty to either party, by written agreement of the parties. Yankee may terminate the contract, without penalty, by written notice if it is unable to obtain the necessary licenses or regulatory agency approvals or satisfactory liability insurance coverage.

Modification

The contract may be modified by written agreement of the parties. Examples of possible modifications cited in the contract are that the contract may be modified to provide for a different reactor type or design if (1) advances in technology make the use of the reactor type described in the contract outmoded as an approach to economically competitive nuclear power or (2) estimated power costs substantially exceed the original estimates upon which Yankee's second proposal, dated August 22, 1955, was based.

Term of contract

The contract commences June 4, 1956, and ends 5 years after a license to operate the facility has been issued.

PROVISIONS APPLICABLE ONLY TO WORK REIMBURSABLE BY AEC ($4 MILLION)

Accounts, records, and inspection

The system of accounts used by Yankee for this work is to be satisfactory to AEC and in accordance with generally accepted accounting principles. Financial reports are to be submitted to AEC as requested. Records and accounts are subject to AEC inspection and audit at all reasonable times. Similar provisions are to be contained in all negotiated cost-type subcontracts.

Subcontracts and purchase orders

Yankee is to use methods, practices, and procedures in subcontracting and purchasing which are acceptable to AEC. AEC approval is required for all subtracts, and AEC reserves the right to approve all purchase orders.

Property

AEC reserves the right to furnish any property or services required for this work. Title to all property furnished by AEC and all materials, equipment, and other property for which AEC may reimburse Yankee is to be vested in AEC. AEC reserves the right to inspect and to accept or reject such property.

Drawings, designs, specifications, and related data

All data of this nature, originated as a result of this work, are the property of AEC and subject to AEC inspection at any time.

Renegotiation

This work is subject to the Renegotiation Act of 1951, as amended, and the contract is deemed to contain all the provisions required by section 104 of such act.

COMMENTS ON CONTRACT PROVISIONS

The following comments relate to the contract provisions summarized in the previous section.

WAIVER OF SPECIAL NUCLEAR MATERIAL USE CHARGE

AEC's change in policy on the material use charge waiver is discussed on pages 20 through 22, where it is pointed out that the revised policy results in an estimated additional $1,600,000 loss in revenue to AEC. In addition, we have previously noted that AEC announcements provide that material use charges may be waived up to an agreed-upon amount of money. The contract does not comply with this policy to the extent that it does not specify any limitation on the amount of money of the material use charge waiver but, instead, provides that AEC will waive its use charge for all special nuclear material used during the contract period.

RISK ASSUMED BY YANKEE

In its report dated June 1, 1955, on the original first round proposals, the AEC Selection Board took the following position on risk assumed by the proposers:

"At this stage of development any utility system investing money in an atomic plant rather than a conventional plant is taking many risks. Costs are higher,

performance is less certain, and the contingencies are many. It is difficult, if not impossible, to gage these individual elements of the risk; however the best measure of the total risk is obtained, the Board believed, by considering the dollar investment of the individual groups * * *"

As reported previously, Yankee estimates that its permanent financing program will be about $33 million; however, at October 24, 1956, formal arrangements had not been made to obtain such an amount.

Further, AEC will bear all the research and development costs up to $5 million, and it has informed us that this research and development work should be completed before major construction work begins. AEC has provided us with Yankee's schedule of estimated cash expenditures, by calendar years, for the period 1956 through 1960. This schedule shows that Yankee's major expenditures of funds will be made in 1959 and 1960. AEC believes that it is pertinent to note that its estimates show that Yankee will incur substantial commitments in earlier years for the construction contracts and purchase orders it will have placed incident to starting construction work.

In evaluating the contractor's risk, consideration should also be given to the contract provision which allows Yankee to terminate the contract at any time if it is unable to obtain satisfactory liabilty insurance coverage.

ASSURANCE AGAINST ABANDONMENT OF PROJECT

Among the criteria that AEC stated it would employ in evaluating proposals was "assurances given by the maker of the proposal against abandonment of the project." The contract does not provide any penalty in the event of abandonment of the project. Further, the sponsoring companies of Yankee do not guarantee the performance of the contractor.

In its report dated June 1, 1955, on the original first-round proposals, the AEC Selection Board took the following position on assurances given by proposers against abandonment of the project:

"* * * Each of the proposing organizations expressed its intention to see the project through to completion once started provided unforeseen technical difficulties did not arise which would clearly make it impracticable to complete the work. The Board feels that the Commission cannot expect any stronger assurances. The companies involved will invest substantial amounts of money and will have considerable prestige at stake. A decision to abandon the project once started, is unlikely to be taken lightly. The degree of commitment, of course, varies as the project proceeds * * *. At the same time, the Board desires to call to the attention of those negotiating contracts for any of these projects that they should assure themselves that the Government's contribution is not made in advance of satisfactory evidence that the organization is diligently pursuing the work * * *."

EFFECTIVENESS OF AEC'S CONTROLS

Controls over technical aspects of work

We believe that the contract provides a basis for adequate AEC control over the technical aspects of all work performed under the contract. We note particularly the following provision of the contract:

"The Contractor shall, whether the work is performed by it or its subcontractors, keep or cause to be kept records of technical and economic data developed in connection with the overall project and shall supply the Commission with information thereon. The Commission shall have the right to inspect the work and activities of the contractor under this contract at such time and in such manner as it shall deem appropriate."

Controls over accuracy of cost information

Controls over reimbursable work performed by Yankee ($4 million).—The contract provisions applicable to work reimbursed by AEC (see p. 23) provide AEC a basis for adequate control over the cost of such work. AEC can assure itself of the accuracy of cost information prepared by Yankee which pertains to reimbursable work since one of these contract provisions gives AEC the right to inspect and audit all books of accounts and records relating to such work.

Controls over nonreimbursable work performed by Yankee.—The contract does not specifically provide that AEC has the right to audit the cost of nonreimbursable work performed by Yankee. Since AEC is, in effect, buying technical and economic data from Yankee, we believe that AEC should have the right to

audit the reported construction and operating costs in order to satisfy itself that it is receiving accurate cost information. The right to audit is particularly important in the Yankee contract because AEC considers that the greatest contributions from this project will come during actual operations.

As executed, the contract contains the usual examination-of-records provision, specified by section 166 of the Atomic Energy Act of 1954, which gives the Comptroller General the right to examine any directly pertinent records of the contractor or any of his subcontractors involving transactions related to the contract. AEC informed us that during contract negotiations the contractor requested that the foregoing provision be limited in its application to that portion of the work for which payment would be made by the Commission and that the Commission had indicated its willingness to agree to a contract amendment so providing if the Comptroller General should determine this to be legally permissible. One of the basic reasons for the Government's participation in the project was to secure information concerning the cost of nuclear production of energy, and, while it is true that the Government will not bear any of the construction or operating costs, such costs are an essential element of the overall knowledge which is the main consideration moving to the Government under the contract. Accordingly, on October 10, 1956, the Comptroller General informed the Commission that an amendment to the contract precluding our audit of construction and operating cost data would subject the contract to question.

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington, D. C., February 23, 1957,

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. DURHAM: In connection with your review of the report by the General Accounting Office of the contract between the Atomic Energy Commission and the Yankee Atomic Electric Co., it may be helpful to you to have a copy of our letter to the GAO commenting upon the report in draft form. A copy of this letter is enclosed.

We have reviewed our contractual relationships with the Yankee Atomic Electric Co. in the light of the GAO report. While the sponsoring companies have not yet made binding agreements regarding their capital contributions, the company has been assured by the board of directors of each of the sponsors that they will be prepared to do so at the appropriate time. It is our plan to maintain a continuous followup on the progress in translating these assurances into firm commitments, and should any unanticipated adverse developments occur, we will reexamine our contract in the light thereof.

The GAO also recommended that in the future we obtain guaranties that applicants perform the work contemplated in their proposals. While, in general, we agree with the GAO recommendation, it may not be reasonable, irrespective of any circumstance, to demand absolute guaranties of completion of a project which by reason of its developmental nature conceivably could encounter technical obstacles of a magnitude not now foreseen. In respect to the Yankee contract, we are satisfied that, based on performance to date, the applicant is proceeding in accordance with the proposal and we know of no adverse circumstances at this time likely to change its plan. Sponsorship by the following companies is, we believe, assurance of a responsible proposal:

New England Power Co.
The Connecticut Light & Power Co.
Boston Edison Co.
Central Maine Power Co.
The Hartford Electric Light Co.
The Connecticut Power Co.
Western Massachusetts Electric Co.
Public Service Company of New Hampshire
Montaup Electric Co.
New Bedford Gas & Edison Light Co.
Cambridge Electric Light Co.
Central Vermont Public Service Corp.

As pointed out in the report, the AEC has the right to audit any expenditures which it will reimburse; and we believe, under this particular contract, that the additional right to secure full and complete information regarding costs provides all of the necessary information which we need concerning the experience to be gained from this project.

We appreciate the comments of the GAO and you may be assured that their recommendations will be given due consideration in the negotiation of any future contracts of this nature.

Sincerely yours,

K. E. FIELDS, *General Manager.*

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington 25, D. C., February 13, 1957.

A. T. SAMUELSON,
Director Civil Accounting and Auditing Division,
United States General Accounting Office.

DEAR MR. SAMUELSON: This is in reply to your letter of January 4, 1957, transmitting for our consideration draft copies of the report of the General Accounting Office on its review of AEC's contract with Yankee Atomic Electric Co.

It is understood from recent discussions with your representatives regarding the draft, that it is being recast in certain respects in the light of the further information and explanations growing out of these discussions. As stated to your representatives, it is the AEC's intention to make every effort to secure binding financing agreement and performance guaranties in those cases where the proposer is sponsored by other companies and to have its files pertaining to pending and future contract negotiations fully reflect these efforts. Similarly, we propose to contractually obtain the right to examine such financial data pertaining to the costs incurred under the contracts, as is pertinent and necessary to the accomplishment of our programmatic purposes, irrespective of whether such costs are borne by AEC. While on the foregoing matters our position accords with that expressed in the report, there are other matters in the report which we believe warrant explanation and clarification. These are commended upon below.

The report correctly indicates that the use charge waiver period was changed from "up to 7 years from July 1, 1955" under the first round to "5 years from the operating license" under the second round, and that this second round period was included in the Yankee contract. Recognition needs to be given to the basic reason for this change, which in turn explains the propriety of its application to not only Yankee but also to other proposers. Essentially, the change was directed at overcoming the inequality in benefits which it developed would accrue to different contractors as a result of the use charge waiver period expiring in all cases by the same date. For example, this inequality would exist as among contractors entering the program at different dates, since the period of operations subject to the waiver would be progressively shortened (by operation of the June 30, 1962, cut-off date) for the newcomers. Thus, the establishment of a waiver period covering in each case a fixed number of years of operations, rather than a period ending on the same date in all cases, is more expressive of the intent of AEC since it affords equal benefit to all proposers by allowing for variations not only in the time that the proposers enter the program, but also in the time required to negotiate contracts and to carry out the development, design and construction phases of the projects.

The change in the use charge waiver period is unrelated to the provision of additional economic assistance to small plants, at which the second round was directed. This economic assistance is provided through AEC participating in the cost of and taking title to the reactor plant under the second round. Thus, it would be our suggestion that item 3 at the foot of page 20 of the draft report be deleted since it is not one of the factors beraing upon this change in the use charge waiver period.

With regard to a monetary limit on the use charge waived, until engineering design of the Yankee reactor core has further progressed the quantity and physical characteristics of the special material on which the monetary limit of the use charge waived would be based cannot be predetermined with sufficient accuracy to permit establishment of a definitive monetary amount representing the value of the material required of AEC throughout the waiver period. This engineering design is in turn contingent on the results of the several years of research and development which precede the engineering design of the reactor core. As experience is gained from the design of the early demonstration reactors, however, it is to be expected that the general characteristics of cores will become established to the point where special material consumption can be predetermined with sufficient definiteness to permit a related dollar limitation on

AEC's use charge waiver being negotiated and included in future contracts, particularly where reactors of the same type are involved. It should be borne in mind, however, that notwithstanding the absence of any monetary ceiling on the amount of use charges waived under the Yankee Contract, the contract does provide AEC with controls (which the report characterizes as adequate) over the technical aspects of all work under the contract. Through these controls, AEC is in a position to exercise surveillance over the quantity and grade of special material furnished by AEC and its proper economic utilization by the contractor.

The reference to risk appearing on page 28 of the draft report should be corrected in order to remove any impression that the contractor will have assumed comparatively little risk prior to calendar year 1959. As we have already advised your representatives, our estimates show that Yankee, in addition to having substantially paralleled AEC's expenditures through the end of calendar year 1958, will have incurred materially greater commitments in calendar 1957 for construction contracts and purchase orders it will have placed incident to starting construction work.

As requested, all copies of the draft report are returned herewith.

Sincerely yours,

K. E. FIELDS, *General Manager.*

CHAMBER OF COMMERCE OF THE UNITED STATES,
Washington 6, D. C., March 4, 1957.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
United States Capitol, Washington, D. C.

DEAR MR. DURHAM: The Chamber of Commerce of the United States has been gratified by the great progress which has been made in this Nation to utilize atomic energy for the benefit of our citizens. The Congress has contributed substantially to this progress by making it the "policy of the United States that * * * development, use and control of atomic energy shall be directed so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise" (sec. 1, Atomic Energy Act of 1954).

A basic question, however, has now arisen as to whether private enterprise or the Federal Government will build atomic power reactor's for civilian use. The National Chamber believes the Federal Government should not enter directly into commercial exploitation of the use of atomic energy. The production for sale to the public of electric power from atomic material should be the responsibility of electric utilities and local agencies. The chamber will have more to say on this subject when hearings are held on the civilian atomic power acceleration program.

In spite of the progress made in the short time since enactment of the Atomic Energy Act of 1954, there are still some roadblocks in the way of even more rapid development of the constructive uses of atomic energy which can be removed by legislative action.

One such problem is that of providing protection for the public against hazards from unanticipated atomic incidents. Passage of the bills by Senator Anderson (S. 715) and Congressman Price (H. R. 1981) would go a long way toward solving this problem.

The chamber would appreciate the opportunity of giving the Joint Committee a more detailed statement on this subject when hearings are held on Federal indemnity.

The Public Utilities Holding Act of 1935 also is a roadblock. The amendments to this act, which were reported out of the Joint Committee on Atomic Energy in the 84th Congress, would have prevented the act from operating as an obstacle to atomic-energy development. The action of the Securities Exchange Commission in amending its rule U–7 may have reduced the urgency for the need of amendments to the act. The SEC action is not an entirely satisfactory solution. Under the change in rule U–7, the SEC would determine whether a company in question is engaged primarily in research and development and, therefore, should be entitled to exemption from the Holding Company Act. The amendments proposed last year would have given this decision to the Atomic Energy Commission—a more technically qualified agency to make such a determination. Perhaps specific legislative authority to this regard would prove more beneficial in the long run.

It is the hope of the National Chamber that the recently announced tripartite agreement on declassification of restricted information will have the desired effect on making technical information more widely available to potential users of atomic energy. The free exchange of nonmilitary information is vital to further rapid development of the atomic art. Teachers, writers, and others outside of the AEC's access permit program—upon whom we should depend to train and educate much needed scientists and engineers of tomorrow—have been entitled to receive and report only declassified information. Perhaps the declassification of nonmilitary atomic power reactor information as called for in the tripartite guide will contribute to a sound and progressive atomic energy industry.

As a further stimulant to progress in this field, normal patent rights, as established by the patent statutes, should be applied to all peaceful applications of atomic energy. Compulsory licensing of patents, inventions, and discoveries is basically inconsistent with an inventor's proprietary rights in the results of his enterprise. The claims of the Government with respect to the inventions of private persons should be restricted to enforcement of rights specifically reserved by contracts providing for work at the expense of the Government.

These suggested deterrents to atomic energy developments are, of course, in addition to the well-recognized technical problems which are facing the creative genius of our scientists and engineers in harnessing the constructive force of the atom.

I would appreciate it if you would make this letter a part of the record of your committee hearings pursuant to section 202 of the Atomic Energy Act of 1954.

Cordially yours,

CLARENCE R. MILES.

AMERICAN-STANDARD,
ATOMIC ENERGY DIVISION,
Redwood City, Calif., February 19, 1957.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States, Washington, D. C.

DEAR MR. DURHAM: In reference to your letter of January 18, 1957, concerning hearings by the Joint Committee on Atomic Energy scheduled for February 19, 20, and 21, and February 26, 27, and 28, 1957, please permit me to offer the following comments relative to two of the items on your list of suggested topics for discussion:

1. *Reactors types other than for electric power.*—Atomic reactors for space and process heating appear to be economic in certain situations abroad where a large concentrated demand for heat exists. Such situations occur in paper mills, large new housing projects, and certain heavy industrial plants. Since fuel oil costs in many foreign nations are now as high as $1 per million British thermal units, a reactor has a good chance to compete. We believe that the United States should take the lead in developing such systems by installing them at new Government installations such as Army and Air Force bases.

2. *International market for reactors and components.*—We believe that the recently announced third power demonstration program should be officially extended to include the possibility of research and development assistance to reactors that would be constructed abroad. Because of the different financial situation and the desire for natural uranium, certain reactors types of great interest abroad may never be attractive to the utility industry in the United States. Hence, the United States power industry cannot be expected to exhibit interest in reactor types which may form the basis of much of the export market for atomic equipment. In order to stimulate the development of the foreign market, serious consideration should be given to waiving heavy water charges and use charges on uranium to friendly foreign nations.

I sincerely hope that these comments will be of some help to your committee. I want also to take this opportunity to thank you and all of the members of the committee for the deep and sincere interest that has been taken in considering the problems of the industry.

Respectfully yours,

FRANK A. PARKER, *Director.*

WESTINGHOUSE ELECTRIC CORP.,
Pittsburgh, Pa., February 19, 1957.

HON. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States, Washington, D. C.

DEAR MR. DURHAM: I would very much like to thank you for the invitation to participate in the committee's hearings on the development, state, and growth of the atomic-energy industry. During the last session of Congress, I appeared before the committee and discussed the various reactor projects we have under contract. Since then, our contractual obligations have not been materially changed. I understand that the committee closely follows the naval reactors program in which we participate and is aware of our work in this area. At the same time, those other organizations with whom we are working in the field of commercial atomic power are making statements to the committee during the current hearings concerning the progress of their projects.

Technical problems continue to be the No. 1 obstacle to progress in the development of nuclear power. Although there have been many favorable developments during the last year, I cannot overemphasize the magnitude of the engineering job ahead. As I have consistently emphasized over the past 3 years, an atomic powerplant is still far from being an off-the-shelf item.

As a supplier of power equipment, we are finding that our new product, the nuclear reactor and its associated equipment, is experiencing the same effect of cost increases as other apparatus which the company manufactures and sells. This general trend of increased prices and higher construction costs, coupled with the continued technical problems which are being encountered, means even higher hurdles to the country's goal of economically competitive atomic power. Althought we are continuing to spend millions of dollars of company funds for reactor development and associated manufacturing projects, we are very aware of the unsatisfactory cost picture with which we are faced at the present time.

One evidence of the current effect of cost increases has been our deferment of the start of construction of the Westinghouse testing reactor, in which we have already invested about $2 million.

I have previously discussed with the committee the need for financial protection against the risks of public liability arising from the operation of atomic reactors. There is indemnity legislation presently before the committee designed to render the needed assistance. The proposed legislation relates solely to domestic facilities, but the problems of insurance and indemnity are just as acute in the foreign field. We do not believe, however, that legislative relief is necessary to assist American exporters such as Westinghouse. Perhaps the most immediate protection to such exporters could be provided by inclusion of a supplier indemnity clause in agreements for cooperation between the United States and foreign countries.

I shall be pleased to appear before the committee as you discuss specific topics and legislative proposals and contribute to your deliberations to the maximum extent possible. Again let me thank you and the committee for the invitation to appear in the section 202 hearings and for the continued interest you have shown in the day-to-day difficulties of our industry.

Sincerely,

CHARLES H. WEAVER, *Vice President.*

PENNSYLVANIA POWER & LIGHT CO.,
Allentown, Pa., March 7, 1957.

HON. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States, Washington, D. C.

DEAR MR. DURHAM: As you know, Dr. W. E. Shoupp appeared before the Joint Committee on February 26, 1957, to report on the status of the PAR project, a joint undertaking of Westinghouse Electric Corp. and this company. Based on review of the transcript of the testimony on that occasion, we are furnishing the supplemental information set forth below in order to clarify the situation as regards costs of the project.

1. The capital cost of the plant was stated in the hearings to be in the area of $300 a kilowatt. This figure is in accord with our most recent cost analysis and since it relates to a proposed plant of 150,000-kilowatt capacity the total

amount is $45 million. This amount excludes site acquisition and development costs, which are estimated at $3 million at the present time. Also excluded are research and development costs.

2. The figures relating to current cost estimates should be considered as tentative and preliminary. We are at present at a midway point in phase I, and we expect that with more information appropriate modifications in present cost estimates will be required. For example, the final decision as to whether chemical processing facilities will be on-site or off-site, or owned by a chemical company or by P. P. & L. will affect both the total cost of chemical processing and the distribution of such cost as between capital and operating expense. At a future date, when more information has become available to us, present estimates as to total capital cost and total cost in mills per kilowatt-hour might be either lower or higher. For this reason, it has been a source of real concern to us that there be no misunderstanding or lifting out of context of the preliminary cost figures that we now have in hand as a result of the project work to date.

We do again express our appreciation for the opportunity that was afforded to submit to the Joint Committee a progress report on the project. For the future, we shall continue to send to the committee a written monthly progress report and generally keep the committee informed of current developments. In this connection, at any time convenient for the committee or any of its members, we would like to make available for inspection and review the laboratory and test facilities which have been created for the PAR project and are in service in Pittsburgh.

Sincerely yours,

JACK K. BUSBY.

WALTER KIDDE NUCLEAR LABORATORIES, INC.,
Garden City, N. Y., March 4, 1957.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States, Washington, D. C.

DEAR CONGRESSMAN DURHAM: I am happy to accept your kind invitation to submit a statement for the hearings currently being held by the Joint Committee on the development, growth, and state of the atomic-energy industry.

I wish to call your attention to a problem that confronts our organization and that, I am sure, is shared by other companies performing services for the Government in the atomic-energy field. Walter Kidde Nuclear Laboratories is an independent, self-supporting company of relatively small size (120 staff members). Its activities are confined entirely to design, consulting, and research and development in the atomic-energy field. Although the portion of its work that is performed for private industry is increasing steadily, a major portion is still done for the Government. By the nature of the atomic-energy program, this situation is bound to continue for some years.

Our company is not supported as a part of a large manufacturing operation but derives its entire income from consulting engineering. In our opinion, this is a valuable asset. We can approach nuclear problems without bias of any kind. It appears that our effort is the kind of thing the Atomic Energy Commission publicly encourages.

However, for this kind of effort, we have been told that in spite of the unique quality of our work—in spite of the contributions to a difficult technical program—in spite of the fact that our past work has been done at unusually low cost—our maximum fee can be 6 percent of the engineering cost—and that this is AEC policy from which we have no appeal. With this decision, we would be rewarded with about $12,000 (before 52 percent taxes) for $200,000 worth of top-quality engineering in a new and complex field. From this amount we must pay advertising expenses, the cost of preparing proposals, and other normal expenses of doing business today that the Government does not recognize. In addition, we must carry our technical staff on the payroll during periods of slack work. We must also compete for competent engineering and technical personnel in the same labor market with nonnuclear firms who have manufacturing or other operations to fall back on when research work is temporarily cut back.

Fees of this amount may have a background in the design and construction of conventional buildings, airports, or other wartime projects. However, they are not proper for complex, conceptual nuclear design by consulting engineering firms, or for research and development work of an original and difficult nature, requiring a staff of experienced nuclear physicists, mathematicians, nuclear

engineers and chemists, chemical engineers, mechanical engineers, and other specialists.

I would respectfully suggest that the portion of this type of work performed for the Government on a contract and subcontract basis is so large a part of the total effort of this kind as to place the Government in a monopoly position in setting the rates for this work. For example, in the publication Chemical and Engineering News for February 4, 1957, it is reported on page 28 that a recent survey of the National Science Foundation shows that of $5.4 billion spent for research and development in the United States in 1953, $2.8 billion was provided by the Government and $2.4 billion by industry. I am confident the figures for the atomic-energy field would show that the Government's share was even higher. In this situation, companies like our own are in fact not free to choose whether they will or will not work for the Government, however free they may be to do so in principle.

With this background, I would like to submit that the level of fees being paid by the Government for the kind of services we provide is too low. This works a hardship on companies like our own and this, in turn, is harmful to the atomic-energy program, since it may stifle interest in the industry.

It is therefore our urgent recommendation that the Government policy in the matter of fees for research and development, conceptual engineering, and consulting services in the atomic-energy field be reviewed with particular attention to separating such services from the fee policy that covers large manufacturing or construction projects or engineering projects of more routine nature, and to recognize the legitimate costs of operating a technical organization not recognized in the present policy. We feel such a review is as important to the atomic energy industry as it is to companies like our own.

A second matter on which I would like to comment very briefly is the development of reactor types other than for electric power. Our company has recently been devoting considerable attention to the study of reactors for applications other than electric power, such as chemical processing, materials irradiation, and provision of heat. We are among those whose answers to a recent atomic industrial forum survey indicated that the chief drawback to the development of an atomic-power industry in the United States is a lack of economic incentive.

We are likewise among those who feel that the development of reactor types for other than power purposes offers definite promise of profitable development and that they should receive increased support in the Government program.

Sincerely,

W. E. KELLEY, *President.*

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, October 18, 1957.

Mr. LEWIS L. STRAUSS,
Chairman, United States Atomic Energy Commission,
19th and Constitution Avenue NW., Washington 25, D. C.

DEAR MR. STRAUSS: In connection with the Joint Committee's study of selected activities in the field of civilian application, the committee desires to give consideration to pertinent recommendations of the McKinney panel with a view to determining what the Commission has done or proposes to do with regard to these recommendations. Of particular interest are the following:

1. GOVERNMENT ORGANIZATION

Recommendation No. 1.—That the Commission provide a real focal point within its organization at which are concentrated authority and responsibility for defining the integrated objectives for research and development of the peaceful uses of atomic energy, both at home and abroad, for establishing definite requirements with time scales for accomplishment of these objectives, and for assuring expeditious execution of the necessary programs and projects.

2. RESEARCH AND DEVELOPMENT

Recommendation No. 3.—That the Commission be encouraged and, if necessary, required to state its research and development objectives and programs in detail on a current basis so that industry can have a firm base in knowledge on which to make its decisions.

3. HAZARDS AND PROTECTION

Recommendation No. 1.—That the Commission be encouraged to step up its program of research into the causes, effects, and control of atomic hazards; the 2 or 3 years remaining before any full-scale "demonstration" atomic powerplant comes into operation must be used to obtain the maximum amount of information in order that both those concerned with protection against harmful levels of radiation and those concerned with providing insurance to cover such damage as may occur can have the most advanced knowledge possible at the earliest time.

4. CONTROL OF INFORMATION

Recommendation No. 3.—That the Joint Committee require the Commission to undertake the compilation of both classified and unclassified information relating to peaceful uses of atomic energy on a continuing and current basis so that it can be available in ready reference form for those entitled to use it.

The Joint Committee would appreciate the cooperation of the Commission staff in connecetion with the committee's studies of the above matters.

Sincerely yours,

CLINTON P. ANDERSON, *Chairman.*

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington, D. C., November 26, 1956.

Hon. CLINTON P. ANDERSON,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR SENATOR ANDERSON: The staff of the Joint Committee and the Commission have been discussing the progress made in various fields covered by the recommendations of the McKinney panel on the impact of the peaceful uses of atomic energy as mentioned in some of your recent letters.

One of the subjects discussed with your staff is the program for compiling information useful to industrialists in forms best suited to their purposes.

On October 30 last, representatives of the AEC's Division of Information Services described to Messrs. Ramey and Brown of your staff in some detail the current steps which are underway and those planned for the future in this field of activity.

At Mr. Ramey's request, we are attaching a summary of this verbal briefing.

Sincerely yours,

LEWIS L. STRAUSS, *Chairman.*

Attachment: Summary of verbal briefing

PROGRESS IN COMPILING TECHNICAL INFORMATION ON PEACEFUL APPLICATIONS OF ATOMIC ENERGY IN READY REFERENCE FORM FOR USE BY INDUSTRY AND SCIENCE

Speeding and widening the flow of technical information within the Government atomic energy projects and among science and industry generally has been a prime concern of the Atomic Eenergy Commission since its establishment. To make the thousands of individual AEC documents reporting data and findings most useful to those entitled to have them, an extensive system of preparing and supplying reference tools has been maintained since 1947. Abstract journals, both classified and unclassified, covering the AEC-originated literature and that coming from other sources around the world are published biweekly. Bibliographies have been compiled and issued. Catalog cards have been built up by now numbering 66 and covering each United States metropolitan area of more than 500,000 population. Establishment of a system of classified depository libararies at 6 to 10 locations is being considered.

Early in the development of a civilian applications program under the Atomic Energy Act of 1954, it became apparent that these services, extensive though they were, would not meet all needs of industry acquiring access permits or industry wishing to enter atomic energy development in its unclassified phases only.

The Commission, early in fiscal year 1956, expanded the existing technical literature services and moved to supplement them with new programs.

These actions were underway when the panel on the impact of the peaceful uses of atomic energy began its study, and were discussed with the panel.

The Commission, naturally, agreed with the panel recommendation No. 3 in chapter IX, "Control of Information" of its report to the Joint Committee pointing to the need for making information available in ready reference form for those entitled to use it. The General Manager in testimony before the Joint Committee in February 1956 during the hearings pursuant to section 202 of the act briefly set out (in remarks appearing on pp. 54 and 76 of the published hearings) the Commission's approach to solution of this problem.

During the 9 months since that time, the programs have been further particularized. There follows a summary of progress made toward this end and action contemplated for the future:

A. REFERENCE TOOLS ON REPORT JOURNAL ARTICLE AND MONOGRAPHIC LITERATURE

1. Bibliographies and abstracts

The Joint Committee has been provided with packets containing (1) the unclassified abstract journal, Nuclear Science Abstracts, available to anyone; (2) the two classified abstract journals Confidential Reports for Civilian Application and Secret Reports for Civilian Applications, available to holders of access permits; (3) the bibliographies of both classified and unclassified material similarly available; and (4) the lists of new publications issued by the Commission and put on sale by the Office of Technical Services, Department of Commerce, the Superintendent of Documents, Government Printing Office, and the Commission's Technical Information Service extension at Oak Ridge.

The Commission has devoted intensive effort to sharpening the bibliographical service available so that it will best meet the needs of industry. Besides the 700 classified and 1,200 unclassified bibliographies from all sources reported in the lists issued up to September 1955, the Commission itself compiled in the year ending October 1, 1956, 26 additional confidential, 12 additional secret, and 44 additional unclassified bibliographies—a total of 82 new bibliographies specially pointed toward industrial use of atomic energy.

A list of the new bibliographies prepared and issued by the Commission during the past year is attached as annex A.

2. Model reference center

For industrial concerns who wish to send their own literature search teams to a center where everything is available, the Commission has established a model reference center in its Technical Information Service extension at Oak Ridge. Available there are a complete collection of AEC-developed reports of industrial use, both classified and unclassified (44,000 in number—18,000 classified and 26,000 unclassified), a master card catalog, bibliographies, lists of available documents, and other reference aids.

3. Literature search service

For those who wish to search the literature but do not have a search team within their organizations, the Commission has arranged to provide such service supplying on any specified topic either literature titles or, if it is requested, specific tabulated data. This service is sold to users at $6 per hour. It is expected to be particularly useful to small-business concerns not possessing large files and resources.

4. Catalog card service

Catalog cards on newly issued reports are available on sale to access permit holders or other industry.

5. Engineering drawing service

Engineering drawings originating in the Commission projects are now available on sale through photographic reproductions. The list now includes sets of over 3,000 items; it is expected that 2,000 more items will be added in the next year.

6. Depository libraries

During the year, 17 libraries were added to the list supplied with all unclassified publication of the Commission. The total is now 66, and there is at least 1 library in each metropolitan area of 500,000 or more population in the United States. The Commission is now considering establishment of 6 to 10 classified depository libraries located for the convenience of holders of access permits.

B. PREPARATION OF BOOKS SUMMARIZING KNOWLEDGE IN INDIVIDUAL INDUSTRIAL FIELDS

As the panel on the impact of peaceful uses of atomic energy commented, in its report to the committee, and as the Commission staff had reported to the panel, the provision of reference tools to aid in using the report, journal articles, and monographic technical literature is not enough. To fill in the gaps, and to help place the smaller enterpriser on an even footing with the larger corporation with extensive technical information services, it is necessary to compile the existing information by fields into summary volumes surveying the main bodies of data. This is not a new situation. Its existence earlier in the atomic-energy program led to the Commission's national nuclear energy series of 39 classified and 35 unclassified compendia and monographs summing up the technical knowledge developed by the work of the wartime Manhattan Engineer District; also to the preparation by individual authors under contract or by groups of authors on a contributory basis of texts in general and special fields such as the Sourcebook on Atomic Energy, Nuclear Reactor Engineering, Energy in the Future, the four volumes of The Reactor Handbook, etc. All of these were financed by the Commission either as an incident to research and development contracts or under specific contract with individual authors.

To meet the need for new texts useful to industry, the Commission undertook, as the General Manager reported to the committee last February, an expanded program of writing summary volumes. Again, some are being prepared as an incident to research and development contracts, and some under specific contract with the firms which prepare engineering handbooks, or with individual authors.

Attached as annex B is a list of the 21 new volumes of revision of existing volumes now under preparation, and of the 6 new volumes to be contracted for in fiscal 1957 by the Division of Information Services, and the 14 planned for contracting in 1958, subject to the availability of funds. An additional number of volumes also will be prepared as an incident to research and development contracts in the current and coming fiscal years, but this list is not yet collected.

Starting in March 1957, a new volume will be published each 60 days. Two have already been issued.

Looking further forward, the Division of Information Services has compiled a list of titles which should be written by the end of fiscal 1961. This list may include some titles which the commercial technical publishing industry will wish to prepare and sell. The Division of Information Services will take the list of titles to the publishing industry and will not contract for preparation of any titles which the industry wishes to prepare. There is one difficulty in handling of such titles by commercial industry, namely, that the first text of most of the volumes will have to be prepared on a classified basis to serve access permittee; and then to get unclassified volumes, deletions will have to be made. The result may be that 50 to 75 percent of the titles will have to be handled by the Commission. The list of contemplated titles in each of 11 fields is attached as annex C.

Titles already under preparation and contemplated are drawn from experience with requests of access permittees and other industrialists for report literature, and from consultations with permittees and AEC field offices, program divisions, and contractors.

C. PROVISION OF QUARTERLY TECHNICAL PROGRESS REVIEWS COVERING 10 MAJOR INDUSTRIAL FIELDS

No matter what speed and thoroughness are put into the program of contract preparation either through research and development contracts or through writing contracts, the books cannot be kept current enough to supply the needs of the developing atomic-energy industry. Therefore, a completely new program is being undertaken in fiscal year 1958, with preparations starting in fiscal year 1957. This is the preparation and issuance of 4 quarterly Technical Progress Reviews in each of the 10 subject-matter areas. These reviews will bring up to date for the preceding 3 months the finds in technology and science in each of the 10 fields. In other words, there will be 40 summary-type topical reports issued each year to keep industry abreast of the new things in technology and science coming out of the AEC-financed development programs and, so far as possible, the industry-financed programs. This will not compete with the journal literature of the scientific and technical societies or with the business press

and its service to industry. We have discussed the program with the Advisory Committee on Industrial Information, composed of representatives both of the societies and the business press, and they have agreed that it is a needed service which cannot be rendered by the existing journals and papers but will be complementary to their more frequent reporting to industry. We are stepping up our reporting service to the journals and papers in order to help them keep their readers well informed on a monthly or more frequent basis.

About half the Technical Progress Reviews will be issued on a classified and unclassified basis, the other half on an unclassified basis only. The unclassified will be printed by the Government Printing Office and sold by the Superintendent of Documents; the classified will be printed and sold by the Technical Information Service Extension at Oak Ridge. The list of subjects to be covered by the 10 series is attached as annex D.

D. MONTHLY REPORT TO MANAGEMENTS OF SCIENCE AND INDUSTRY

AEC policy and program information is as important to management as technical information is to the scientists and engineers. In order to convey this information on a current and continuing basis, the Commission plans to start early in calendar 1957 a monthly report on these matters to industry. It will be issued as a periodical and sold by the Superintendent of Documents.

E. CONTINUING SERVICE TO INDUSTRY THROUGH THE PROFESSIONAL AND TRADE PRESS

For 5 years, the Division of Information Services has maintained a special service to the engineering journals, the business press, and the labor press conveying technical information at a stage before it reaches report issuance, and providing reports of policy action. The above journal for management will not conflict with this service. Indeed, the Commission has consulted the Advisory Committee on Industrial Information, composed of editors of the engineering society journals and the business press, and they have encouraged the idea of the monthly report, at the same time endorsing further expediting of the service to their groups of periodicals which report on specific lines of interest to technical and management individuals.

ANNEX A

CLASSIFIED BIBLIOGRAPHIES PREPARED SINCE SEPTEMBER 1955 AND PUT ON SALE THROUGH THE TECHNICAL INFORMATION SERVICE, OAK RIDGE

Classified confidential

1. Recovery of Uranium From Magnesium Fluoride Scrap (TID–3062).
2. Enriched Uranium Fuel Materials (TID–3065).
3. Nuclear Technology. A Bibliography of Selected Classified Report Literature (TID–3080).
4. Feed Materials. Part I (TID–3081).
5. Feed Materials. Part I, Supplement I (TID–3081).
6. Welding and Brazing (TID–3201).
7. Corrosion (TID–3202).
8. Shielding (TID–3203).
9. Shielding, Supplement I (TID–3203).
10. Zirconium (TID–3204).
11. Criticality (TID–3206).
12. Uranium Recovery From Raw Materials (TID–3207).
13. Titanium (TID–3208).
14. Thorium (TID–3209).
15. Thorium Metal Production (TID–3210).
16. Slow Coast Down Study (LS–7).
17. Oak Ridge Research Reactor Project (LS–8).
18. Neutron Counting Flux Measurements and Related Techniques and Reactor Control System (LS–21).
19. Uses of Ball Bearings in Water Moderated Reactors and of Permanent Magnets in Reactor Control Systems (LS–23).
20. LITR Fuel Handling (LS–25).
21. Fuel Failure Detecting Systems (LS–26).
22. Molten Lithium (LS–27).
23. Magnetic Recording of Transient Pulse Phenomena (LS–29).

24. Niobium and Niobium Alloys (LS–30).
25. Thorium Rolling (LS–31).

Classified secret

26. Bibliography of U. S. AEC Reports Available Through the Civilian Application Program (TID–3063 and 4 Supplements).
27. Welding and Brazing (TID–3101).
28. Corrosion (TID–3102).
29. Shielding (TID–3103).
30. Zirconium (TID–3104).
31. Thorium (TID–3109).
32. Thorium Metal Production (TID–3110).
33. Criticality Data on U–235 (LS–1).
34. ORSORT Study Reports (LS–5).
35. Uranium Oxide Bibliography (LS–9).
36. Effects of Precipitation on Fallout (LS–13).
37. Preparation of Thorium Chloride and Thorium Fluoride (LS–15).
38. Information on Control Rod Drive Mechanisms (LS–33).

UNCLASSIFIED BIBLIOGRAPHIES PREPARED SINCE SEPTEMBER 1955 AND PUT ON SALE THROUGH OFFICE OF TECHNICAL SERVICES

1. Literature Survey of Treatments for Monazite Sands (AECD–4127).
2. A Bibliography of Available Digital Computer Codes for Nuclear Reactor Problems (AECU–3078).
3. Literature Survey on Columbium (CF–51–8–256).
4. Sintering Mechanism as Applied to Refractory Oxides: A Bibliography. Supplement I, 1952–1955 (ISC–288).
5. Annotated Bibliography of α–Furil Dioxime (ISC–699).
6. Annotated Bibliography of 1,2–Cyclohexanedionedioxime (ISC–738).
7. Bibliography—Delayed Neutrons (LAMS–199).
8. Vacuum Sparking: A Bibliography (LRL–158).
9. Determination of Alkali Metal and Alkaline-Earth Elements by Flame Photometry (ORNL–2001).
10. Bibliography of Cyclotron Literature (ORNL–2023).
11. Zirconium. A Bibliography of Unclassified Report Literature (TID–3010).
12. Unclassified Bibliographies of Interest to the Atomic Energy Program (TID–3043).
13. Thorium (TID–3044).
14. Exploration for an Investigation of Minerals of Interest to the U. S. Atomic Energy Commission Program (TID–3053).
15. Annotated Bibliography on the Transport and Deposition of Atomic Debris (TID–3061).
16. Enriched Uranium Fuel Materials (TID–3064).
17. Feed Materials (TID–3084).
18. Welding and Brazing: A Bibliography of Unclassified Report Literature (TID–3301).
19. Corrosion (TID–3302).
20. Radiation Shields and Shielding (TID–3303).
21. Heat Transfer (TID–3305).
22. Uranium Recovery From Raw Materials (TID–3307).
23. Thorium (TID–3309).
24. Thorium Metal Production (TID–3310).
25. Particle Accelerators. I. Bibliography. II. List of High-Energy Installations (UCRL–2672).
26. List of Unclassified References on Columbium (Niobium) (WASH–294) Part 2.
27. Platinum Plating (LS–2).
28. Silicone Rubbers (LS–3).
29. Reactor Control Instrumentation Miniaturization (LS–4).
30. Sources of Supply for Pure Iron (LS–6).
31. Polonium-Beryllium Neutron Sources (LS–10).
32. Use of Technitium as a Corrosion Inhibitor (LS–11).
33. Titanium Purification on a Laboratory Scale (LS–12).
34. Transducers and Methods of Reducing Elastic Hysteresis in Flat Metal Diaphragms (LS–14).
35. Purification of Zirconium on Laboratory Scale (LS–16).

36. Physical Properties of Helium (LS–17).
37. Unclassified Information on the Control Instrumentation Systems of the Oak Ridge Research Reactor (LS–18).
38. Thermal Conductivity of Sodium Chloride at High Temperature (LS–19).
39. Radiation Tolerance and Dielectric Strength of Hard Anodize Aluminum at 500° F. (LS–22).
40. Sodium Purification (LS–22).
41. Air Particle Monitoring (LS–24).
42. Use of Ion Exchange Resins in Water Decontamination (LS–26).
43. Diffraction Patterns of Rare Earth Compounds (LS–28).
44. Separation of Aluminum From Uranium in Analysis (LS–32).

TITLES OF BOOKS UNDER PREPARATION IN FISCAL YEAR 1957 AS A PHASE OF RESEARCH AND DEVELOPMENT CONTRACTS OR CONTRACTED FOR BY THE DIVISION OF INFORMATION SERVICES IN FISCAL YEAR 1956

Contracted for by the Division of Information Services in fiscal year 1956

1. Nuclear Radiations in Industry and Science.
2. Recovery and Processing of Uranium Ores.
3. Hot Laboratory Equipment Catalog.
4. Directory of Tables of Nuclear Constants and Numerical Data.
5. Atomic Energy Facts.
6. Treatment and Disposal of Radioactive Wastes (High Level).
7. Reactor Control and Safety.
8. Production of Uranium Metal.
9. Production of Thorium Metal.

Under preparation as a phase of research and development contracts in fiscal year 1956 and fiscal year 1957

1. Reactor Heat Transfer Handbook.
2. Reactor Plant Piping Handbook.
3. Reactor Core Design Manual.
4. Metallurgy of Uranium.
5. Corrosion and Wear Handbook for Water-Cooled Reactors.
6. Hafnium Handbook.
7. Naval Reactor Physics Design Manual.
8. Basic Reactor Shielding.
9. Revision of Reactor Handbook, Volume I: Physics.
10. Revision of Reactor Handbook, Volume II: Engineering.
11. Revision of Reactor Handbook, Volume III: Materials.
12. Revision of Reactor Handbook, Volume IV: Fuel Processing.

BOOK TITLES PROPOSED FOR CONTRACT PREPARATION BY DIS, FISCAL YEARS 1957 AND 1958

Book titles for fiscal year 1957

1. Fuel Fabrication Techniques.
2. Homogeneous Reactor Systems.
3. Sodium Graphite Reactor Systems.
4. Pressurized Water Reactor Systems.
5. Liquid Metal Fuel Reactor Systems.
6. Chemical Processing of Nuclear Materials.

Book titles for fiscal year 1958

1. General Nuclear Safety.
2. Controlled Thermonuclear Processes.
3. Boiling Water Reactor Systems.
4. Fast Breeder Reactor Systems.
5. Organic Moderated Reactor Systems.
6. Reactor Operators Manual.
7. Effects on Radiation of Materials.
8. Nuclear Health Physics.
9. Reactor Instrumentation.
10. Radiation Chemistry.
11. Industrial Isotope Case Histories.
12. Pumps for Nuclear Systems.
13. Nuclear Propulsion of Merchant Ships.
14. Management and Control of SF Materials.

SUBJECTS FOR PROPOSED TECHNICAL BOOKS ON ATOMIC ENERGY TO BE COMPLETED BY 1961

This is a tentative planning list of subjects for books on various phases of atomic energy. These subjects were selected as those on which technical books should be written and published within the next 5 years to encourage the development of atomic energy applications with full participation by industry.

Considerable revision of the list is expected with technical and other developments. The subjects are listed without regard to classification. Most of the books would certainly be unclassified; some, classified, many would be issued in classified versions for access permittees and, after necessary deletions, in unclassifield versions for industry and science generally.

The list is broken down into 11 categories. The Atomic Energy Commission does not expect to publish on a subject on which a private firm undertakes publication in a reasonable time.

Category 1. Reactors

AEC Requirements for Reactor Safety Reports.
A Survey of Reactor Safeguard Reports.
Nuclear Propulsion for Merchant Ships.
Zero Power Reactors (the different types and their use for testing reactor materials).
Critical and Subcritical Assemblies (the different types and their use in reactor design).
Design and Operation of Research Reactors.
Design and Operation of High-Flux Testing Reactors.
Nuclear Power Cost Estimates.
Economic Considerations in the Design of Reactor Systems.
Pressurized Water Reactor Systems.
Boiling Water Reactor Systems.
Estimated Growth in Number of Power and Research Reactors and Their Fuel Requirements.
Reactor Control and Safety.
Sodium Graphite Reactor Systems.
Homogeneous Reactor Systems.
Organic Moderated Reactor Data.
Shippingport Operating Experience.
Power Reactor To Drive Gas Turbine.
Liquid Metal Fuel Reactor Systems.
Fused Salt Reactor Systems.
Package Power Reactors for Civilian Use.
Sodium-cooled, Heavy-water-moderated Reactor Systems.
Water-cooled, Graphite-moderated Reactor Systems.
Power Reactor Operation and Maintenance (one book for each major power reactor system).
Use of Nuclear Energy for Space and Process Heating.
Manual for Reactor Operators.

Category 2. Radiation Applications

Uses of Radiation in Medical Diagnosis.
Therapy With Isotopes.
Isotopes in Processing of Pharmaceuticals.
Infestation Control by Isotopes.
Effects of Radiation on Seeds and Plants.
Uses of Research Reactors.
Irradiation of Meats.
Irradiation of Fruits and Vegetables.
Use of Radioisotopes in Industry.
Production of Radioisotopes.
Gauging With Radioactive Isotopes.
Radiography With Radioactive Isotopes.
Tracer Studies With Isotopes.
Uses of Radiation in Chemical Processes.

Category 3. Instrumentation

Reactor Instrumentation.
Environmental Monitoring.
Bioassay Techniques and Equipment.

Laboratory Counting Equipment.
Use of Computers in Atomic Energy Field.
Remote Controlling of Nuclear Industrial Processes.
Instruments for Geologic Exploration.
Use of Nuclear Radiations for Determination of Soil Density and Geological Structure.

Category 4. Spent Fuel Processing

Chemical Processing of Irradiated Fuels.
Recovery of Radioisotopes from Gross Fission Products.
Treatment and Disposal of Low Level Radioactive Wastes.
Pyrometallurgical Separation of Spent Fuel.
Ion Exchange Separation of Spent Fuel.
Solvent Extraction of Spent Fuel.
The Economics of Spent Fuel Processing.

Category 5. Raw Materials

Nuclear Fuels—What They Are, Sources, Reserves, Requirements.
Uranium Geology, Exploration, Mining.
Geology and Geochemistry of Radioactive Materials.
Recovery and Processing of Thorium Ores.
Ion Exchange Processes for Uranium Recovery.
Solvent Extraction of Uranium Ores.

Category 6. Feed Materials

Plutonium Handbook.
Management and Control of Special Nuclear Material.
Reduction Processes for Thorium and Uranium.

Category 7. Fuel Elements

Alloys for Fuel Elements.
Preparation and Use of Liquid Reactor Fuels.
Effects of Radiation and Thermal Cycling on Reactor Fuels.

Category 8. Materials

Beryllium Metal.
Zirconium Metal.
Heavy Water.
Handbook on Boral.
Ceramics and Cermets for Atomic Energy.
Reactor Grade Graphite.
Liquid Metals.
Effects of Radiation on Structural Materials of Reactors.
Effects of Radiation on Reactor Coolants.
Effects of Radiation on Dielectric Materials and Electronic Equipment.
Effects of Radiation on Inorganic Materials.
Effects of Radiation on Organic Materials.
Technology of Rare Earth Elements.
Metal Hydrides.

Category 9. Radiation Safety

Hot Laboratory Catalog (Revision).
Fire and Explosion Control.
How To Live and Work With Radiation Safely.
Safe Use of Radioisotopes.
How To Ship Radioactive Materials.

Category 10. Nuclear Physics and Chemistry

Controlled Thermonuclear Processes.
Separation of Isotopes (B–10, C–14, etc.).
Criticality Problems in the Design of Equipment for Handling Fissionable Material.
The Direct Conversion of Radiation into Electrical Energy.
Particle Accelerators.
Radiation Absorption and Scattering; Application to Shielding Problem.
Radiation Chemistry: Theory of Interaction.
Isotopes Effects on Chemical Reactions.

Hot Atom Chemistry (chemical effects of nuclear changes).
Gaseous Diffusion Isotope Separation.
Electromagnetic Isotope Separation.

Category 11. Miscellaneous (under preparation) (proposed)

Manpower Aspects of Atomic Power Development.
Atomic Energy Abroad.
Government Agencies Engaged in Peaceful Atomic Activities and What They Do.
Legal and Insurance Aspects of Atomic Energy.
Glossary of Atomic Energy Terms at Two Levels—Scientific and Management.
Role of University and Industrial Laboratories in Nuclear Research and Development.
Nuclear Engineering Laboratory Equipment and Its Use in Teaching.
Research Sponsored by the AEC.
AEC Patents Available.
How to Enter Atomic Energy Business.
Argonne National Laboratory Facilities, Services to Industry.
Brookhaven National Laboratory Facilities, Services to Industry.
Oak Ridge National Laboratory Facilities, Services to Industry.
National Reactor Testing Station Facilities, Services to Industry.
University of California Radiation Laboratory Facilities, Services to Industry
Knolls Atomic Power Laboratory Facilities, Services to Industry.
Hanford Plant Facilities, Services to Industry.
Los Alamos Scientific Laboratory Facilities, Services to Industry.
Savannah River Plant Facilities, Services to Industry.

TECHNICAL PROGRESS REVIEWS

(4 issues each year in each of 10 areas)

Unclassified areas

1. Instrumentation.
2. Radiation applications.
3. Raw materials.
4. Radiation safety.
5. Nuclear physics (includes thermonuclear).

Classified areas

(The reviews in these areas will be deleted and unclassified versions published for industry and science generally.)

6. Reactor technology.
7. Spent fuel processing.
8. Feed materials.
9. Fuel element fabrication technology.
10. Reactor materials.

Classified reviews will be distributed by Technical Information Services Extension, Oak Ridge; Unclassified reviews will be distributed by Government Printing Office or Office of Technical Services, Department of Commerce.

FEBRUARY 14, 1957.

MR. JAMES T. RAMEY,
Executive Director,
Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. RAMEY: Please refer to your letter of November 8, 1956[1] confirming arrangements for the study of certain McKinney panel recommendations outlined in Senator Anderson's letter of October 18, 1956. Transmitted herewith are summary statements on three of the panel recommendations under study, dealing with Government organization, research and development, and hazards and protection. The summary statement on control of information was forwarded by letter of November 26, 1956.

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[1]Attached as enclosure A.

We shall be happy to cooperate in every possible way in the further study of these recommendations by the committee staff.

Sincerely yours,

R. W. COOK,
Acting General Manager.

Enclosures: Summary statements.

ATTACHMENT I

GOVERNMENT ORGANIZATION

Recommendation No. 1 * * * "That the Commission provide a real focal point within its organization at which are concentrated authority and responsibility for defining the integrated objectives for research and development of the peaceful uses of atomic energy, both at home and abroad, for establishing definite requirements with time scales for accomplishment of these objectives, and for assuring expeditious execution of the necessary programs and projects."

The Commission has always been mindful of its responsibility to maintain an organization which will:

(1) Define its objectives, both short and long range;
(2) Integrate its various programs effectively;
(3) Establish meaningful programatic time schedules; and
(4) Assure expeditious execution of necessary programs and projects.

The Commission is continually evaluating its organization and programs in order to achieve these ends.

Even before Congress acted upon the Atomic Energy Act of 1954, the Commission was concentrating upon the development of an organizational arrangement through which it could most effectively discharge its responsibilities for * * * "encouraging widespread participation in the development and utilization of atomic energy for peaceful purposes * * * ". Our studies resulted in the establishment of the Division of Civilian Application to handle the domestic aspects of atomic-energy development and utilization, and the Division of International Affairs together with the Office of Special Projects to handle the international aspects of this program. Our studies convinced us, however, that the Commission's basic and fundamental research, engineering, development, and production programs should remain with divisions which had been performing these activities so successfully since the origin of the AEC. It is our view that more efficient use of technical staff, facilities, and resources has resulted from this plan.

As the Commission's programs developed and the workload increased, the need for more effective coordination and direction of the Commission's increasingly varied and complex activities became evident, and the positions of Assistant General Managers were established to serve this end.

The position of Assistant General Manager for Research and Industrial Development was established to coordinate and direct the activities of the Divisions of Biology and Medicine, Research, and Reactor Development. These Divisions are responsible for basic and fundamental research, engineering, and development of both the military and the peaceful uses of atomic energy, and are charged with development and recommending programs which will contribute most fully to the advancement of the art in these areas. The Assistant General Manager for Research and Industrial Development is responsible for seeing that such programs are properly developed and defined. On the basis of his knowledge of these programs, the Assistant General Manager for Research and Industrial Development recommends the level of future programmatic effort in these areas to the General Manager who reviews the individual programs and ascertains that they can be effectively integrated into the Commission's overall program and time schedules before they are presented to the Commission for final approval. Once these programs have been approved by the Commission, the Assistant General Manager for Research and Industrial Development serves as a focal point within AEC with responsibility for assuring expeditious execution of the programs and their related projects.

The Commission has more recently established a focal point for activities in another area of Commission responsibility, that of implementing the President's Atoms for Peace program. The position of Assistant General Manager for International Activities was established to coordinate and direct the activities

of the Division of International Affairs and the Office of Special Projects. Here again, an Assistant General Manager has responsibility for defining and recommending to the General Manager, for submission to the Commission, basic programmatic objectives relating to the Commission's activities in a major field, that of international affairs. As some of these objectives are related to domestic programs regarding research and development in the field of peaceful uses of atomic energy, he is also responsible for coordination with the Assistant General Manager for Research and Industrial Development to assure that our foreign programmatic objectives are developed in harmony with our domestic programs in these fields of atomic energy. Once these programs have been approved, the Assistant General Manager for International Activities is responsible for the expeditious execution of the programs and related projects.

The Commission believes that the organizational arrangements set forth above are effective in carrying out our statutory responsibilities. We have recognized the necessity for establishing several focal points within out organization to coordinate and expedite major programs, once approved, and to recommend programmatic modifications when believed to be necessary. However, we feel that authority for approving broad programs and basic time schedules cannot be delegated below the Commission level.

Since the programs of the Commission are going through a transitional period in which increased emphasis will continue to be devoted to the civilian and peaceful uses of atomic energy, we recognize that our organization structure must be kept under careful scrutiny to determine whether further changes in organization will enable the Commission to function more effectively in this area.

ATTACHMENT II

RESEARCH AND DEVELOPMENT

Recommendation No. 3, * * * "that the Commission be encouraged and, if necessary, required to state its research and development objectives and program in detail on a current basis so that industry can have a firm base in knowledge on which to make its decisions."

1. Information programs

Since the issuance of the McKinney panel report, the Commission has stepped up the dissemination of pertinent research and development information to industry. Information programs which have been utilized to reach this end were outlined in detail in a recent letter from Chairman Strauss to your committee, dated November 26, 1956. Of special note is the fact that the Commission is presently formalizing arrangements for a completely new program, to be initiated in fiscal year 1957 and brought to full scale in fiscal year 1958, which will provide for (1) the issuance of four quarterly technical progress reviews in each of 10 subject matter areas and (2) the issuance each month of an AEC report for managements of research and industry. The quarterly reviews will bring up-to-date for the preceding 3 months, significant findings in technology and science in each of the subject-matter areas.[1] The monthly reports for management will summarize AEC policy and program developments which may open opportunities or have an impact on the plans and activities of research and industrial managements.

2. Access permit program

The Commission has continued to implement its "access permit" program which makes it possible for either industrial organizations or interested individuals to obtain access to restricted data relating to the civilian uses of atomic energy. This program is designed to provide industry with current statements of significant research and development findings in the atomic-energy area. Under the program, for example, the Commission has taken action this year to make thermonuclear data available to holders of access permits. For access to secret restricted data in the thermonuclear category, an applicant must demonstrate, in addition to a need for the data, either that he is engaged in a substantial effort to develop, design, build, or operate a fission power reactor that is actually planned for construction, or that he possesses qualifications which

[1] The 10 subject-matter areas include: (unclassified) instrumentation, radiation applications, raw materials, radiation safety, and nuclear physics including thermonuclear (classified); reactor technology, spent-fuel processing, feed materials, fuel element fabrication technology, and reactor materials.

demonstrate that he is capable of making a significant contribution to research and development in the controlled thermonuclear field. The total number of access holders under the access-permit program has now increased to 1085 (on November 1, 1956).

3. Technical meetings

The Commission has increased the number of technical-information meetings held for the purpose of informing private industry of basic developments in the atomic-energy field. These meetings have been primarily designed to disseminate technical research and development information, and to broaden the base of industrial participation in atomic energy. Meetings have also been cosponsored by the AEC or AEC contractors to provide generalized or technical information on Commission programs. Meetings held and/or scheduled with private industry since January 1, 1956, are listed below. Those identified by the symbol (C) dealt with restricted data, and, accordingly, were limited to persons and organizations holding access permits:

(*a*) Technical-information meetings primarily for dissemination of research and development information:

(1) Homogenous Reactor Program, Oak Ridge, March 21–22, 1956 (C).

(2) Radiation Effects on Materials, Chicago, July 31–August 2, 1956 (C).

(3) SRE–OMRE, Los Angeles, November 8–9, 1956 (C).

(4) Isotopic Analysis of Uranium, Chicago, February 5–7, 1957 (C).

(5) Controlled Thermonuclear Processes, Berkeley, February 20–23, 1957 (C).

(6)[2] Fast Reactors, Chicago, late 1957 (C).

(7)[2] Homogenous Reactor Program, Oak Ridge National Laboratory, May 8 and 9, 1957 (U).

(8)[2] Boiling Water Reactor, Chicago, week of May 27 (U).

(9)[2] Nuclear Safety, New York, late October 1957 (U).

(*b*) Technical-information meetings primarily for broadening the base of industrial participation:

(1) Production of Feed Materials, Cincinnati, January 12–13, 1956 (C). AEC sites opened on a specific schedule to those desiring further production data as result of Cincinnati meeting above:

Production of Feed Materials: Oak Ridge, January 1956; Lemont, February 1956; Paducah, February 1956; New Brunswick, February 1956; St. Louis, February 1956; Oak Ridge, February 1956.

(2) Chemical Processing of Nuclear Fuels, Idaho Falls, January 18–20 (C).

(3) Cold Processing of Enriched Uranium, Oak Ridge, September 13–15 (C).

(4) Magnesium Fluoride Scrap Recovery, St. Louis, November 15 (C).

(5) Accountability for SNM, New York, March 5–7, 1957 (C).

(6) Information Services Available to Access Permit Holders, Oak Ridge, March 1957 (C).

(*c*) Technical information meetings cosponsored by AEC or AEC contractors:

(1) Prospects of Atomic Energy in the South, Atlanta, April 17–18, 1956. Prospects of Atomic Energy in the South, Oak Ridge, April 19, 1956. (Cosponsored by AIF, ORINS, ORNL, Southern Research Institute, Southern Association of Science and Industry, First National Bank of Atlanta.)

(2) Conference on Thorium, Cleveland, October 11, 1956. (Cosponsored by AEC and American Society for Metals.)

(3) Atomic Energy and Agriculture, Tuskegee, March 9, 1956. (Sponsored by Tuskegee Institute in Cooperation with ORINS.)

(4) Atomic Energy and Science: Little Rock, Ark., March 15, 1956; Fayetteville, Ark., March 16, 1956. (Sponsored by University of Arkansas in cooperation with ORINS and ORNL.)

(5) Introduction to Radiological Safety, New York, January 7–18, 1957. (Sponsored by Institute of Industrial Medicine of New York University in cooperation with USAEC officials.)

[2] In preliminary planning stage.

4. Efforts to increase private research and development capabilities

The Commission has informed industry of basic policies which will encourage private research and development capabilities in the atomic-energy field. In October 1956, for example, the Commission announced that it will construct future test reactors only if its needs for irradiation space cannot be met by private industry under contracts reserving for Government use a percentage of the space available in privately owned test reactors, and also that the AEC would use Government test reactors for non-Government purposes only if privately owned facilities were not available.

The above development was in accordance with Commission policy to encourage private research capability in the nuclear field. Under this policy, the Division of Reactor Development, for example, has made contracts in most major fields of research and development to 10 universities and 6 companies conducting research in waste disposal and the utilization of fission products, to 5 companies doing research in all areas of chemical processing and fuel fabrication, and to 8 universities and 1 company doing research in heat transfer. In addition, Brookhaven National Laboratory has joined with a private company in a study of heat-transfer technology specifically related to the liquid-metal-fuel reactor, and other companies are doing research studies in reactor physics, shielding, instrumentation, and on the technical feasibility of conceptual reactor designs.

The Division of Reactor Development has also developed a program permitting use of AEC space and equipment at national laboratories for the establishment of student practice schools in nuclear-energy technology which will be initiated this year.

In addition, feasibility and development studies for the power reactor demonstration program, although partially financed by the Commission, are being conducted by private corporations. The Division has already held three series of meetings with companies involved in power reactor development work and is planning additional conferences in the near future so that the AEC and the companies might coordinate their research and development activities.

ATTACHMENT III

HAZARDS AND PROTECTION

Recommendation No. 1 * * * "That the Commission be encouraged to step up its program of research into the causes, effects, and control of atomic hazards; the 2 or 3 years remaining before any full-scale 'demonstration' atomic powerplant comes into operation must be used to obtain the maximum amount of information in order that both those concerned with protection against harmful levels of radiation and those concerned with providing insurance to cover such damage as may occur can have the most advanced knowledge possible at the earliest time"

The Commission's program of research into the causes, effects, and control of atomic hazards may be divided into two general categories—reactor safety research and biomedical research.

Much reactor safety research is done in the course of development of each specific demonstration reactor project. An example of this was the deliberate sacrifice of the boiling-water reactor, BORAX–1, at the National Reactor Testing Station in 1953. In addition, more generalized experimental work to determine the effects of adverse operating conditions on reactor behavior has been performed at the various national laboratories on a continuing basis.

The current reactor safety research and development program has grown out of this earlier work. The experiments to determine inherently safe reactor characteristics are concentrated in several projects, concerned with various reactor concepts. The SPERT facilities at the reactor testing station are planned to provide test information on several heterogeneous reactor concepts. SPERT–I is being used to study behavior of reactors under very large surges of power. SPERT–II is in the early design stages and will be operated at pressures up to approximately 300 pounds per square inch. SPERT–III, expected to be ready for tests in 1957, will operate at approximately 2,500 pounds per square inch at temperatures in the order of 600° F. This reactor will yield information on power transient and safe operating conditions which will be applicable to both the Shippingport reactor and other pressurized-water reactors now being designed. KEWB–I, built by Atomics International, will supply the same type of information about small special homogeneous reactors. Detailed design of KEWB–II, a

cylindrical-core homogeneous reactor which will be constructed at the Atomics International Santa Susana site, is currently underway. A similar study program for fast reactor concepts is in an advanced planning stage.

In addition to these experiments on various types of reactors, research is also underway and planned on reactor materials and components, and chemical reactions related to reactors.

The Argonne National Laboratory has undertaken fundamental studies of the mechanism of the characteristics of spontaneous ignition of uranium, plutonium, thorium, zirconium, and their alloys. This work will be extended shortly to other reactor fuels, construction materials, and alloys.

Both pressurized water moderated and homogeneous reactors develop mixtures of hydrogen, oxygen, and steam within the pressure vessel. The Commission has contracted with the Bureau of Mines of the Department of the Interior to conduct studies to determine the limits of explosiveness of this mixture. The results of this work should make it possible to predict with some accuracy the scope of hazards of this type that will be incurred with given reactor designs.

The chemical engineering department of Columbia University has been conducting transient heat transfer studies. Aerojet General is determining the mechanism of explosions of molten fuel which sprays into moderating water. The Oak Ridge National Laboratory has been studying the mechanics of fuel elements melted as a consequence of accidental excessive temperatures. Reactor containment is being studied to determine design features which will provide the proper degree of safety.

High-level liquid wastes resulting from chemical processing of irradiated reactor fuels are a major problem. There are presently underway 12 different research programs studying the various possible approaches to the problem of handling these wastes.

As previously indicated to the Joint Committee, the Commission has also undertaken a comprehensive study of the damage which could possibly result from the nuclear runaway of power reactors. A preliminary report is expected to be completed early in 1957. This study will review the features of power reactors pertinent to the release of radiation or radioactive materials, examine the probability of a catastrophic release, and calculate potential damage and injury in the event of various assumed types of release. It will analyze such factors as amounts of radiation or radioactive materials that may be released, effects of meteorological conditions on transport of such materials, areas subject to varying degrees of contamination, concentration of population in such areas, and resulting possible injury to persons and damage to property. This survey is expected to contribute substantially to understanding of the problem of public liability of those engaged in private reactor projects.

In the fiscal year 1955 the Commission expended $336,000 for reactor safety research, and, in fiscal year 1956, $1,432,000. As contrasted with these figures, $6,011,000 has been budgeted for fiscal year 1957. These amounts are in addition to those expended in developing safety features of specific reactors.

The research program concerned with biological effects of atomic hazards is being stepped up as fast as possible, consistent with the availability of research facilities and scientists. The results of these studies are published almost 100 percent in unclassified form in scientific journals and AEC reports and are used by the National Committee on Radiation Protection, the International Commission on Radiological Protection, and the National Academy of Sciences as the basis for their recommendations on radiation safety.

These bodies keep their recommendations under continual review and revise them from time to time largely on the basis of results of biomedical research studies. The Commission's operating standards and its regulation on Standards for Protection Against Radiation agree substantially with recommendations of the National Committee on Radiation Protection.

Examples of such research investigations fall into the following categories:

(1) Hazards which may occur in breathing the resulting radioactive cloud from reactor rupture:
   (*a*) Lung damage.
   (*b*) Absorption of fission products into various organs of the body.
(2) Hazard from fallout due to reactor rupture:
   (*a*) Somatic effects.
   (*b*) Genetic effects.
   (*c*) Life shortening effects.

Both No. 1 and No. 2 above include the hazard of strontium in the air and in food. A great deal of effort on the part of investigators at such places as University of California, Davis Campus, Argonne National Laboratory and other smaller projects has gone into studying biological effects associated with chronic exposure to strontium.

(3) Normal operating problems having to do with biological effects of disposal of reactor waste:

(*a*) Disposal of waste to ground, including associated ecological problems.

(*b*) Disposal of waste in sea, including associated marine biology problems.

(*c*) Meteorology—covering problems in connection with chemical processing plants associated with reactors, for example, hazards of off-gases such as the noble gases (xenon and krypton) and iodine.

ENCLOSURE A

CONGRESS OF THE UNITED STATES
JOINT COMMITTEE ON ATOMIC ENERGY,
November 8, 1956.

MR. ROBERT E. HOLLINGSWORTH,
Assistant General Manager for Administration,
Atomic Engery Commission,
1901 Constitution Avenue NW.,
Washington, D. C.

DEAR MR. HOLLINGSWORTH: This is to confirm arrangements agreed to at the joint meeting of AEC and committee staff members on October 30 with reference to the committee's study of certain matters outlined in Senator Anderson's letter of October 18, 1956. It was understood that the Commission would prepare a summary statement on each of the four recommendations of the McKinney Panel, as listed in Senator Anderson's letter, describing what action is being taken by the Commission.

As the committee is particularly interested in what is being done to inform private industry and the public on developments in the peaceful uses of atomic energy, it was agreed that Mr. Salisbury of the Commission's Public Information Division would, as a starting point, prepare a short summary of unclassified materials currently available to industry and the public, which will serve as a basis for further discussions.

Mr. Ted Brown is the committee staff member assigned to the above study and the Commission's cooperation in providing him information for the study would be greatly appreciated.

Sincerely yours,

JAMES T. RAMEY, *Executive Director.*

Representative COLE. Mr. Chairman, at one time during the course of the hearings, the Commission had promised that they would suggest to the committee the changes in the law which the Commission had in mind. I am not certain whether that matter had been presented to the committee when I was not here.

Mr. FIELDS. I am sure it has not been.

Representative COLE. Perhaps we should have that information.

Mr. FIELDS. I believe Mr. Mitchell can give you a rundown on a number of the things we have under consideration, sir.

Mr. MITCHELL. Mr. Cole, with the exception of the bill on the West Berlin reactor, which of course we have submitted to you, we will have to talk in rather general terms as to areas in which we are giving consideration to proposing amendments, since, as the committee is well aware, we have to get the approval of the Bureau of the Budget before making any specific recommendations.

But I can indicate to you some of the major areas which we are considering. We certainly will be proposing something with respect to indemnity for licenses against public liability. We are aware, of

course, of the bills that have already been introduced on this subject. I cannot tell you yet just what form our proposals will take, but we certainly will have something on that.

We have mentioned also this morning the possibility of suggesting amendments which would clarify the role of the States with respect to health and safety regulations. (See p. 699.)

General Fields mentioned this afternoon two areas involving foreign reactors on which we may have suggestions, one of them giving us the right to make long-term commitments, or at least commitments for a period of years, on the repurchase of byproduct material produced abroad from fuel which we provide, and also authority to make long-term commitments on services in this country such as chemical processing.

Similarly, we may ask you for authority to make long-term commitments for private construction and operation in this country of facilities which we may need in the Commission's own program, such as fuel fabrication and chemical processing.

Then we will also very likely have a number of other suggestions that are of lesser importance, I think. Those are the major areas.

Mr. FIELDS. Mr. Cole, I am sure the chairman would feel I was remiss if I did not say that he and the commissioners wish to present a salary bill for the direct employees of the Atomic Energy Commission itself.

The CHAIRMAN. I also want to congratulate the staff and thank them for their efforts during this lengthy hearings. The Commission has cooperated in a fine spirit. We have received a lot of valuable information.

Mr. FIELDS. I think they have been very useful hearings, sir.

The CHAIRMAN. This will conclude the hearing. The committee is adjourned.

(Whereupon, at 3:30 p. m., Tuesday, March 5, 1957, the hearing was concluded.)

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(A more detailed subject matter index is being prepared and will be issued at a later date)

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